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Some Tests of Air Compressors

THE PORTLAND PLANT

The JOURNAL OF ELECTRICITY

AN ILLUSTRATED REVIEW OF THE INDUSTRIAL APPLICATIONS OF ELECTRICITY, GAS AND POWER.

VOL. I, NO. 6. SAN FRANCISCO, DECEMBER, 1895. YEARLY SUBSCRIPTION, $1.00. SINGLE COPIES, 10 cents.

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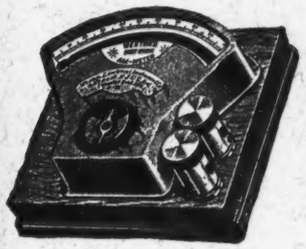

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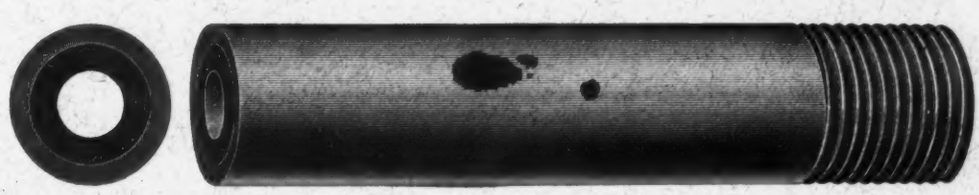

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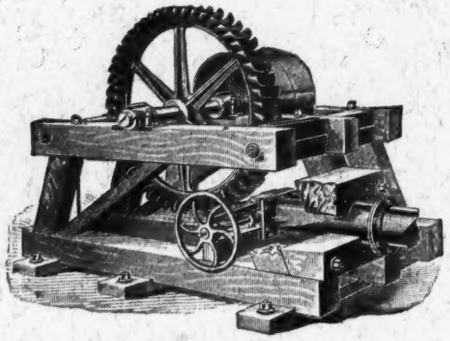

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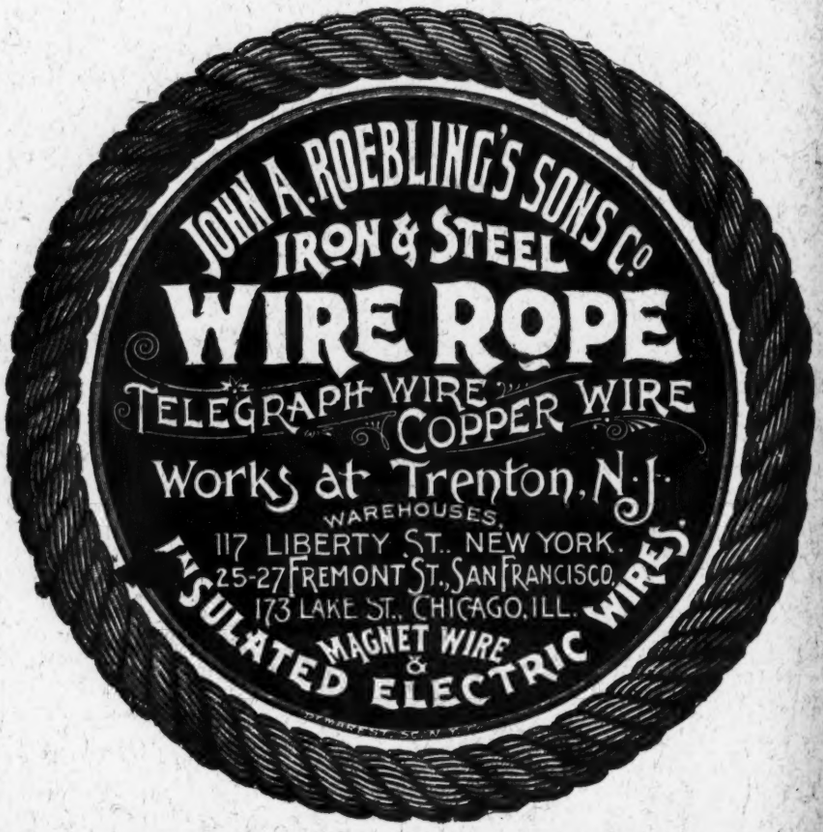

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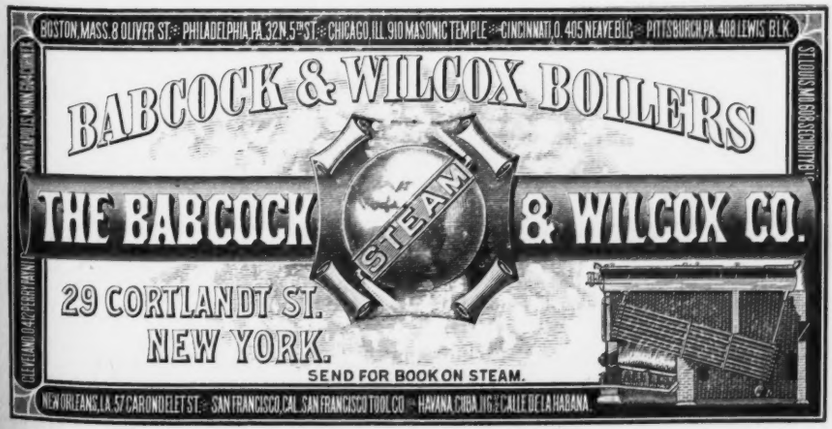
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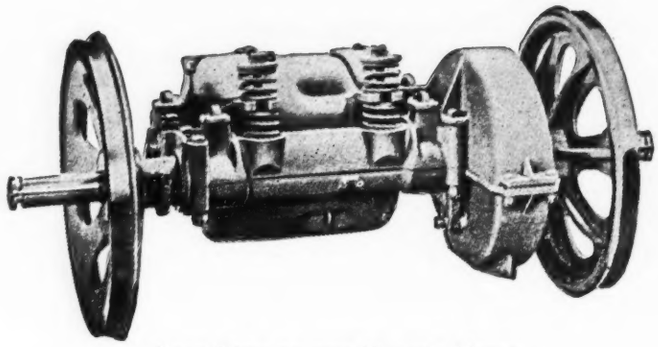

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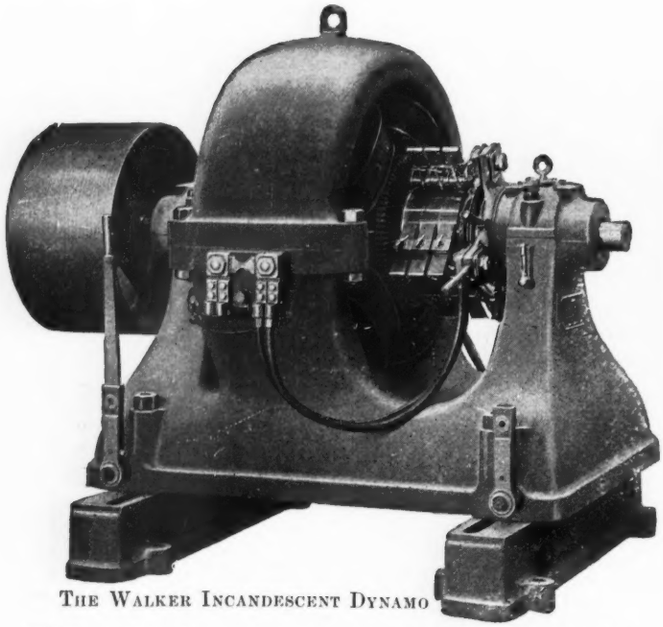

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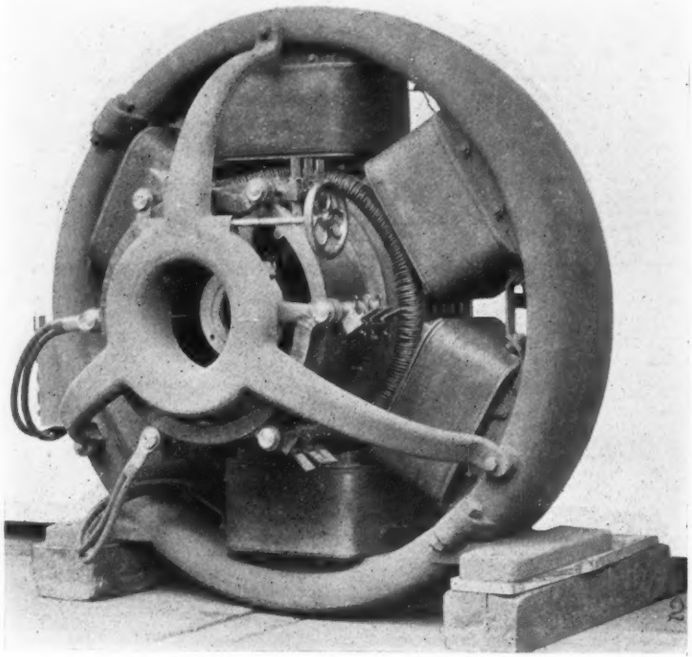

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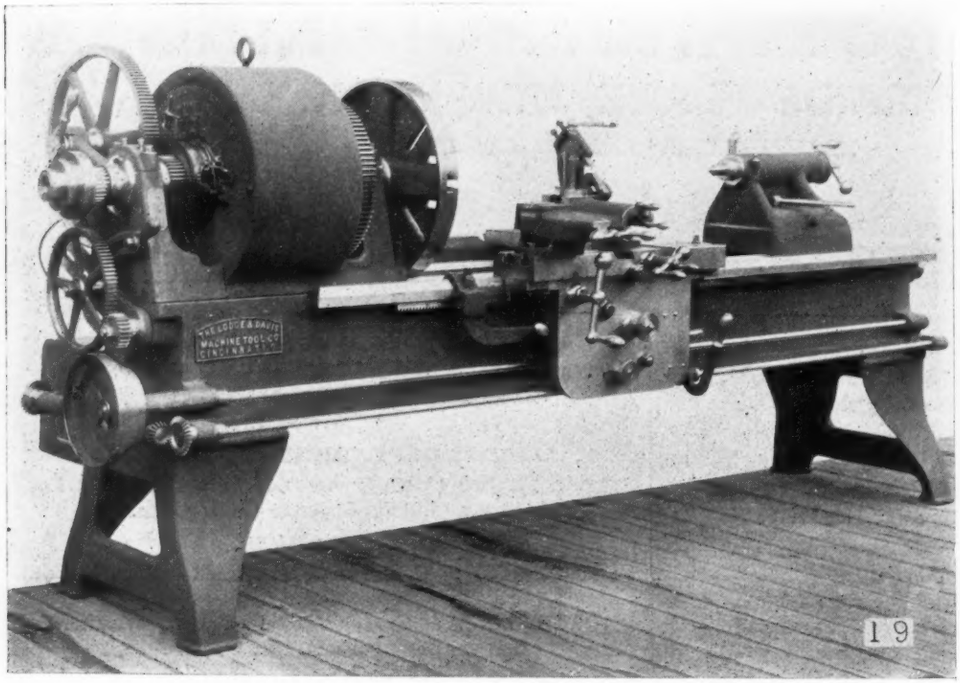

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THE JOURNAL OF ELECTRICITY.

VOL. I. DECEMBER, 1895. No. 6.

Some Tests of Air Compressors.

By A. E. Chodzko, M. E.

Edward A. Rix, P. E.

THE recent tests made by the military authorities on the dynamite guns at Fort Point, San Francisco, may lend some interest to a few particulars regarding air compressing plants, which form the vital element of this installation.

The contract for the construction of the mechanical part of it, with the exception of the guns and their immediate fixtures, was awarded by the Pneumatic Torpedo and Construction Company of New York, and to the Fulton Engineering and Ship Building Works of San Francisco, upon the plans and special designs of Mr. E. A. Rix, P. E., who supervised the construction of the plant.

The compression of air is made in three stages, from the atmosphere to the working pressure of 2,000 lbs. effective per square inch. It is performed in two sets of horizontal engines, to both of which the subsequent description applies, they being in all respects entirely alike. The steam is supplied by four boilers, of the horizontal tubular type, of 750 horse-power capacity, arranged to work either with natural or with forced draught. As will be seen in the annexed outline cut (Figure 3), two steam cylinders connected to the same shaft by cranks at an angle of 145 degrees from each other, each actuate two air cylinders in tandem, that is, through their piston tail rods, there being on one side one low pressure and the intermediate or second stage cylinder, and on the other side one low pressure and the high pressure or finishing cylinder. This duplex set therefore comprises two steam cylinders (Figure 4), operating two intake cylinders (Figure 5), wherein the atmospheric air is compressed to about seventy-five lbs. effective, together with one intermediate cylinder (Figure 6), increasing the air pressure from seventy-five to about 400 lbs. effective, and one high pressure cylinder (Figure 7), which takes the air at 400 lbs. and compresses it to 2,000 lbs. effective. The intake or low pressure cylinders are double acting, that is, they have inlet and discharge valves at each end, while the intermediate and high pressure cylinders are single acting, that is, provided with valves at one end only, their pistons being plunger rams with spherical heads, connected to the tail rods of the intake cylinders.

The special purpose which these compressors have to serve made their design and construction subservient to conditions at entire variance with the lines upon which an air compressing plant is usually established. The main object of the designer, when a large power is to be used, as in the case of the Fort Point installation, is commonly to secure the greatest possible economy in the production of the compressed air. In the present instance compound condensing engines of the most approved type, and air cylinders working at a moderate linear piston speed, would present themselves to the mind as advisable. Such engines would be established

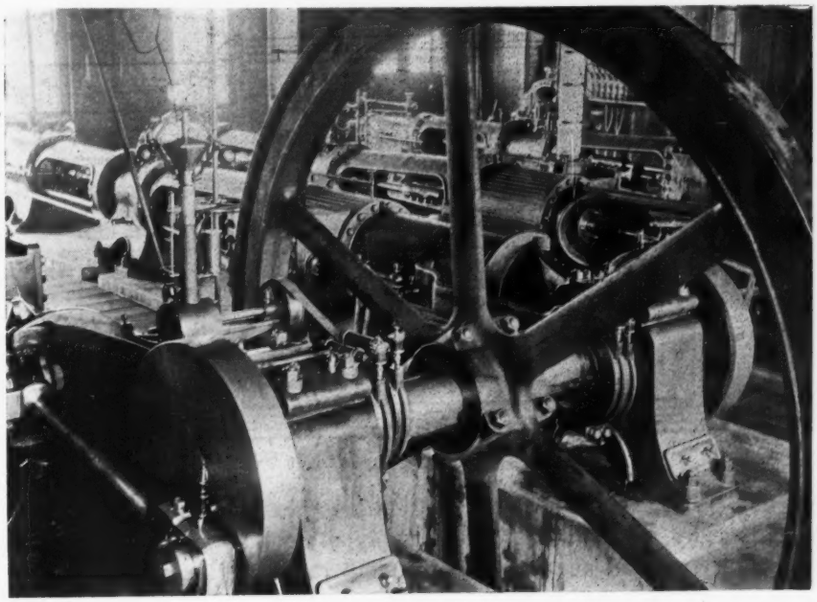

FIGURE 1—*A General View of the Rix Air Compressor Plant.*

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in view of a regular working speed, or approximately so, and everything would be provided to give the economical appliances a chance to work to their full advantage. At Fort Point the primary requirement was to have a plant as little liable as possible to getting out of order. Solidity, simplicity and endurance were therefore the main points to be considered, economy being a desirable but decidedly an accessory feature. Upon

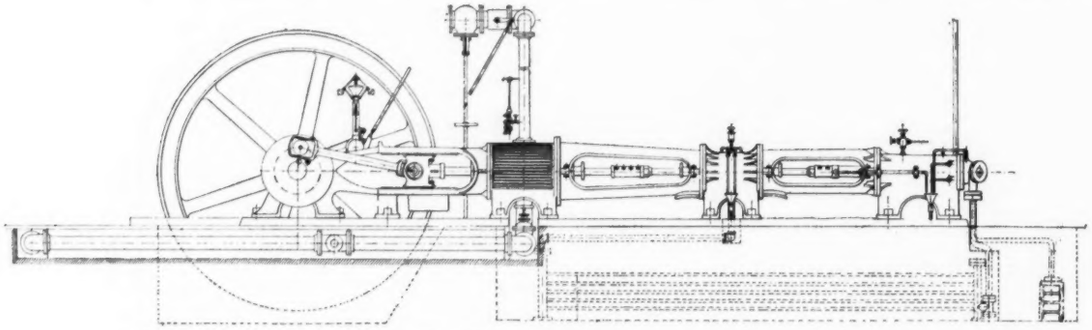


FIGURE 2—*Elevation of the Rix Three-Stage Compressors for 2,000 lbs. Pressure.*

these general lines, supplemented by conditions of capacity within a given time, of efficiency in the means of cooling the air and of practical effectiveness of several important parts, the present plant was designed, built and erected. The steam engines are non-condensing and each cylinder acts independently, that is, no compounding has been adopted. The valves are provided with Meyers' cut-off, regulated by hand, the governors merely acting on the throttle in case of racing. The cranks are set at the angle heretofore indicated, in order that the machine may be balanced as nearly as possible and yet the engines be able to start in any position.

In the air cylinders the greatest care has been used to secure a cooling efficiency as high as possible. The heads and the barrels of the cylinders are water-jacketed,

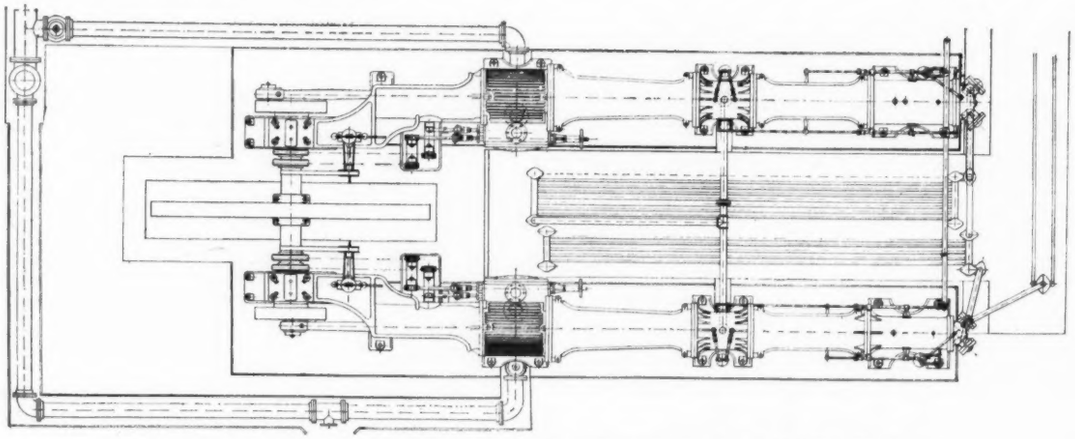


FIGURE 3—*Ground Plan of Rix Three-Stage Compressors for 2,000 lbs. Pressure.*

the water discharge pipes from the jackets being in full view and easily accessible, and the supply of cooling water being regulated according to its temperature at the discharge.

A very elaborate and effective system of intercoolers has been established between the intake and intermediate cylinders, and also between the intermediate and high pressure cylinders. These intercoolers consist of nests of copper pipes extending under the floor in cemented trenches, where a stream of cold water is constantly running. The proportions of these intercoolers have purposely been made very ample, and their effectiveness is fully demonstrated by the low temperature of the air before it enters the intermediate and the high pressure cylinders, which are given hereafter. A similar cooler is provided for the air at working pressure after it leaves the high pressure cylinder and before reaching the twenty-four forged steel storage tubes which, through a complete system of pipes and manifolds, and also a compact arrangement of valves, can be set in communication with each particular gun, or if so desired, with a supplementary storage supply located in the foundation of the guns.

That the demand upon the compressors may vary during action within widely distinct limits was exemplified by the fact that while 360 feet per minute is generally considered as a limit of piston velocity in water-jacketed cylinders, this velocity has been, during part of the trials, carried to 568 feet, or an excess of fifty-eight per cent. At this high rate of speed no undue heating could be observed in the moving parts, and the absence of jarring and of trepidations was the best evidence of the remarkable strength and steadiness of the plant. Of course when working at high speed, no claim is nor could be entertained to maintaining a satisfactory cooling efficiency in each individual cylinder. As before stated, the intercoolers are of sufficient size to deal with the heat liberated during the compression even at high speed. But when the period of compression and of course the

period of effective possible cooling, lasts two-fifteenths of a second, the heat units passing through the cylinder walls during that time cannot be expected to be many. It might be argued that the Riedler compressors in Paris work at a nominal piston velocity of 550 feet, and occasionally 733 feet per minute, but aside from the fact that the use of a spray for cooling and of mechanically moved valves are both combined to reduce the rise of temperature, the pressures in the two-stage Riedler compressor are considerably lower, the air being sent into the mains at only 118 lbs. gauge per square inch, an insignificant pressure as compared to 2,000 lbs. per square inch.

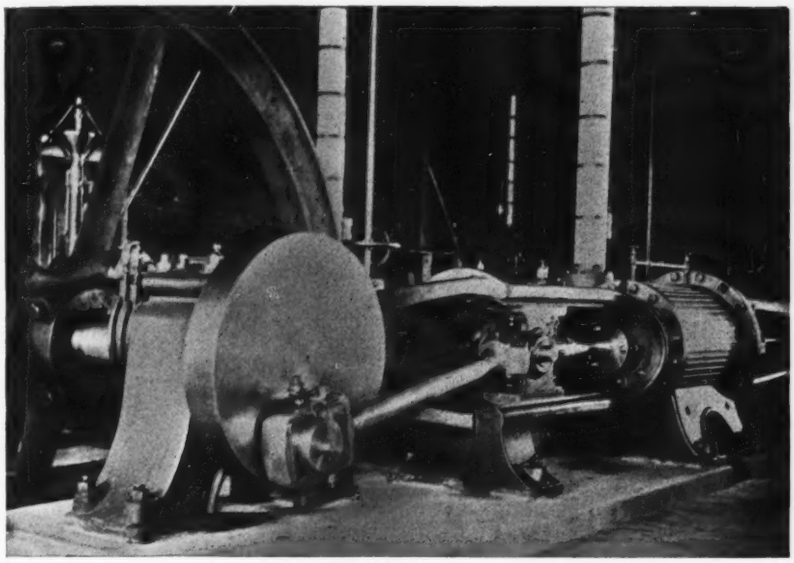


FIGURE 4.—*Meyers' Cut-off Engine, Operating Rix Compressors.*

Another point of interest in the Fort Point plant is the absence of leakage at the stuffing boxes of the intermediate and high pressure rams. This point has been the cause of much annoyance in similar plants built elsewhere, and the present arrangement is the outcome of long and costly experiments. The friction in a running joint capable of holding 2,000 lbs of air pressure against the atmospheric, is necessarily enormous, and after the nature, the shape and the size of the packing had been determined upon, it became necessary to keep the packing sufficiently cool to prevent its rapid wear. This is effected by a special circulation of cold water inside the rams, the arrangement being quite apparent on the general plan, and that it is successfully effected can be easily ascertained. This water circulation also partly contributes to cooling the air under compression. At the nominal rate of speed of about 400 feet per minute of piston velocity, the compressors supply to the storage tubes 460 cubic feet of air per hour at 2,000 lbs. gauge. The annexed abstract from trials made in view of timing the production of the compressors gives interesting evidence of the effectiveness of the intercoolers and of the regularity of the temperature of air at its entrance to each cylinder. For a range of final pressures comprised between 800 and 2,000 lbs. effective, the variation of temperature was only eight degrees Fahrenheit for the intermediate, and three degrees Fahrenheit for the high pressure cylinder, the temperature of the engine room being seventy-five degrees Fahrenheit.

Gauge Pressure Lbs. per Square Inch	Fahrenheit Temperature at Entrance to		
	L.P. Cyls.	I.P. Cyls.	H.P. Cyls.
800	71	67	66
900	71	68	67
1000	71	69	67
1100	71	69	67
1200	71	70	68
1300	71	70	68
1400	71	71	68
1500	71	72	68
1600	71	72	68
1700	71	74	69
1800	71	74	69
1900	71	73	69
2000	71	72	69

The discharge temperature of the low pressure cylinders gradually increased and then remained stationery at 320 degrees Fahrenheit. The intermediate cylinder discharge likewise attained a temperature of 292 degrees Fahrenheit, and the high pressure cylinder, beginning at 375 lbs. per square inch and at a temperature of sixty-six degrees Fahrenheit delivered from the intercoolers, gradually rose in temperature as the pressure increased until it reached 2,000 lbs., and after running at that pressure for one hour the thermometer indicated its maximum, viz., 358 degrees Fahrenheit. The sum total of those temperatures, viz., 970 degrees, as compared to the adiabatic temperature of single-stage compression to 2,000 lbs., which is 1762 degrees Fahrenheit, indicate the work saved by the three-stage method of compres-

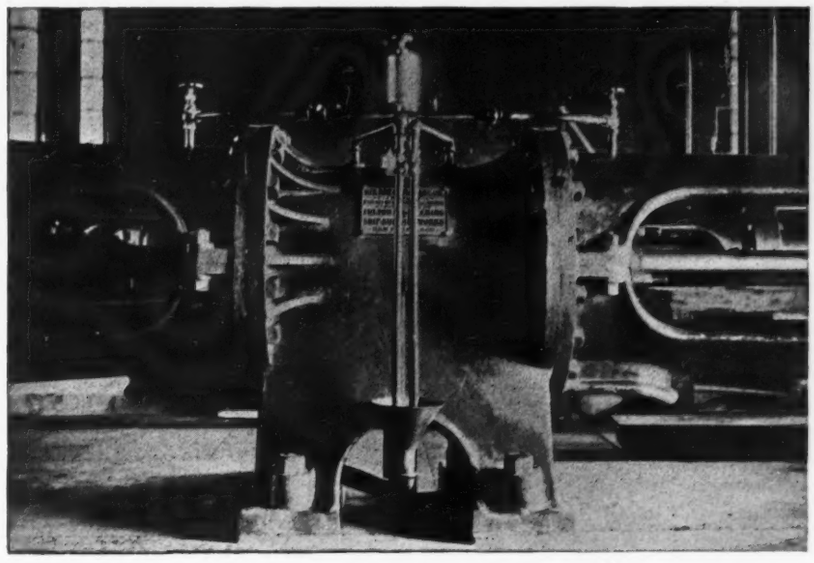


FIGURE 5—*One of the two Initial Air Cylinders of the Rix Compressors.*

sion combined with the jacket and ram cooling devices. The compression throughout the whole range was practically regular, being on an average 115.1 lbs. for each 500 revolutions of both machines.

The mean of many cards taken from the steam cylinders, which is reproduced in Figure 10, showed that each compressor absorbed 342.61 I.H.P., while the cards from the three air cylinders showed 293.78 I.H.P. for each compressor. The work then absorbed by the friction, inertia, etc., was 48.83 I.H.P., or 14.2% of the indicated power employed, showing a mechanical efficiency for the compressor of 85.8%, which is high, especially in view of the facts that the engines were new and consequently stiff to some extent, and also that some extra friction is developed at the ram stuffing boxes as compared with a compressor working at the usual air pressures.

The resisting load of 48.83 H.P., while the compressors were doing full duty, may be compared with the friction load on the machine without air pressure, and an interesting result obtained. Cards taken showed that this friction load was 32.4 H.P., being .663 of the resisting work under load and showing an increase of 50.7% in the resistances between no load and full load. The combined indicator cards illustrated herewith (Figure 10), are plotted from actual cards and show a saving of 36.8% over adiabatic single-stage compression.

The boilers for this plant are of the return tubular type and manufactured by the Chandler & Taylor Company of Indianapolis, Ind. They are seventy-two inches in diameter by sixteen feet long, and of a nominal H.P. of 500, which was increased by the forced draught employed to about 750 H.P. These boilers were tested to 150 lbs. to the square inch, and fully satisfied the requirements of the Treasury Department. The forced draught was employed because it was not considered desirable to continue the stacks above the roof and thus give an opportunity for invading forces to discover the position of the plant. A short stack, about fifteen feet in length, was therefore erected. The forced draught is instituted by two Sturtevant fans, with engines attached, having cylinders three inches in diameter by a three and a half-inch stroke. These fans each deliver 12,000 cubic feet per minute of free air through a twenty-two-inch main, which, passing underneath the battery of four boilers, is connected to each by a ten-inch outlet underneath the grate bars. It was found during the test that these fans need be run only to about 60% of their capacity. The engines exhaust their steam into two National heaters of 300 H.P. each, which furnished feed water to the boilers, at a temperature of 200 degrees Fahrenheit.

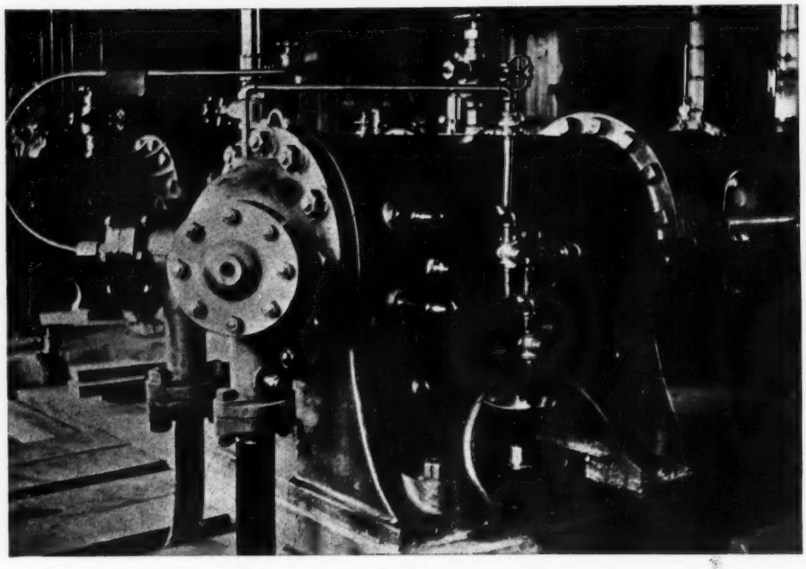


FIGURE 6—*The Intermediate Ram of the Rix Compressors.*

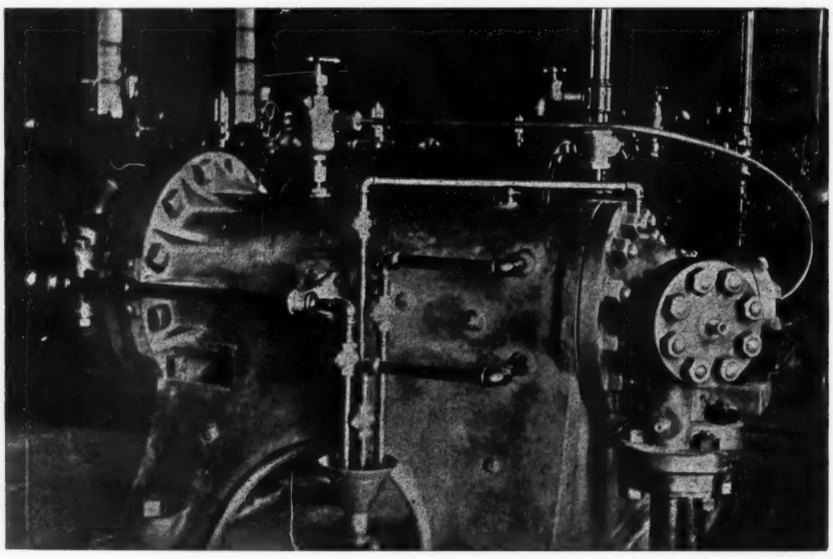


FIGURE 7—*The High Pressure Ram of the Rix Compressors.*

The feed pumps are of the Deane type, being duplex and two in number; the steam cylinders being six inches, the water cylinders being four inches and the stroke being six inches. At a slow piston speed these pumps furnished all the necessary water, which was drawn from the pits after being heated by the air from the compressors. As an auxiliary there are installed alongside of the feed pumps two Nathan injectors of 300 H.P. each, which are amply sufficient to furnish all of the water necessary to feed the boilers. During the test for rapidity of firing, while the plant was supposed to be strained to its utmost, the firemen had ample time to observe the operation of the compressor plant, showing that the boilers were more than sufficient to supply the steam necessary for the

proper operation of the compressors. The electrical equipment of the installation, which was furnished by the Electrical Engineering Company of San Francisco, consists of one thirty-five K.W. compound wound dynamo, shown in Figure 8, and capable of being worked up to

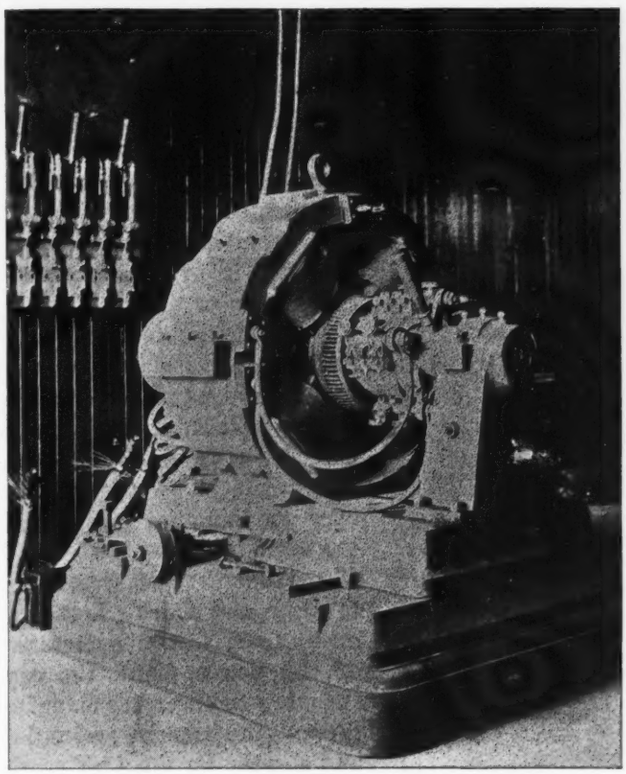


FIGURE 8—*The 35 Kilowatt Generator, manufactured by the Electrical Engineering Company of San Francisco.*

25% in excess on its rated capacity for thirty minutes without undue heating. This dynamo, which is driven by a fifty H.P. Armington & Sims' engine (Figure 9), operates about forty lights in the power house and furnishes the current necessary for operating the electric motors by which the guns are handled. A substantial switchboard, consisting of slate slabs bolted to an iron frame, has been erected immediately back of the dynamo, and on which are placed the necessary fuse blocks, Weston instruments and three 300 ampere main line switches. From the switchboard about 800 feet of lead-covered concentric cable is run through an underground conduit in separate circuits to the motors operating the three guns.

The compressed air, after leaving the compressors and being confined in the storage tanks, is distributed to the three guns independently, through a manifold of bronze, having attached five gauges. two registering 2,000 lbs. and three registering 1,250 lbs., all so arranged with valves that any or all of the guns could be operated at once. This air is carried to the underground storage reservoirs of the guns, through a pipe having an outside diameter of $2\frac{1}{2}$ inches and inside diameter of $1\frac{5}{8}$ inches, and duly tested to 3,500 lbs. to the square inch for tightness. From the guns to these manifolds there are also three copper pipes, each $\frac{1}{4}$ inch inside diameter by $\frac{1}{2}$ inch outside diameter, to register the pressures at the manifolds that are contained in the carriages of the guns. This is in general the description of the air compressing plant.

We now come to speak of the guns themselves, which were manufactured at the West Point foundry on the Hudson, each fifteen inches in diameter with a length of fifty feet. Each gun is perfectly balanced on its carriage, weighing about seventy tons, which is in turn mounted upon concrete foundations. The tests of these guns for their mechanical efficiency, which may be called their ease of operation, showed that they could be traversed by the electric motors which were situated in the gun carriage, in an average of one minute throughout the entire 360 degrees, and they could be changed from extreme elevation to extreme depression in from eight to eleven seconds. Any one familiar with the length of time necessary to operate ordinary powder guns by hand, will appreciate the fact that this facility of operation is marvelous.

For testing these guns for mechanical efficiency the requirements were, first, that forty-five shots should be fired in the first hour and thirty shots in the hour succeeding. Inasmuch as the wastage of air would be the same whether actual projectiles were fired or whether the air was simply wasted through the muzzle of the gun in "air shots," no projectiles were fired in this test, and it was found for the first hour that forty-five shots were fired, and the compressors running at their normal

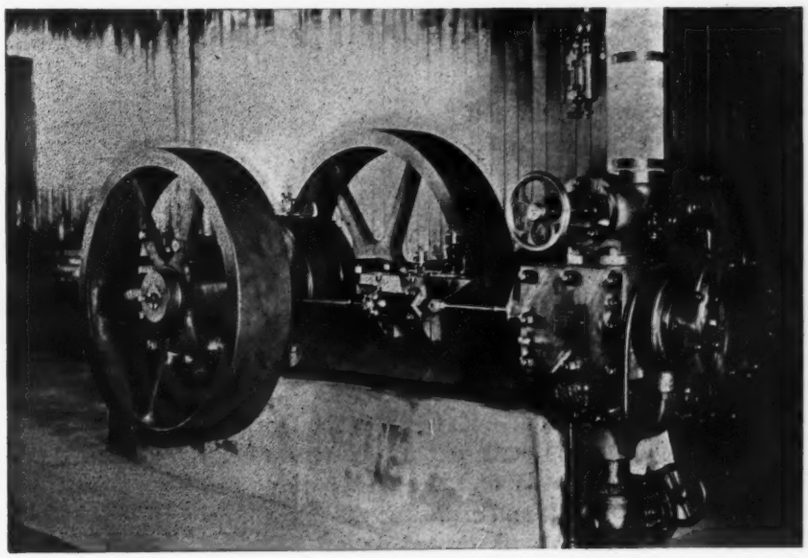


FIGURE 9—*Armington & Sims' Engine, driving the "Double E" Co.'s Dynamo.*

speed registered a final pressure of 1,800 lbs.; it being thus demonstrated that the compressors were amply sufficient to maintain any requirements which might be placed upon the gun. Twenty air shots were fired to ascertain the utmost rapidity with which the guns could

be discharged, and the same were discharged in seven and one-half minutes, though the contract did not require that these shots should be discharged inside of thirty minutes; it being thus demonstrated that the compressors and the guns were amply capable to maintain the test required by the government.

The test for rapidity of firing with actual projectiles next took place. The projectiles used were pieces of gas pipe twelve inches in diameter and eight feet long, loaded with sand. The weight was 1,040 lbs. Each one of the three guns was required to fire five of these projectiles in twenty minutes. The test developed the fact that these projectiles were all discharged from each gun within eight and one-half minutes, and they were by far the most interesting feature of the whole test.

Having no means for maintaining the accuracy of their flight, these projectiles were nevertheless thrown for the first one-half distance of their flight with precision, that is, they maintained the position of a well-directed projectile, after which they tumbled end over end and fell into the sea. Without any plain table measurements being taken upon them, they apparently fell quite accurately within a small target. The time of flight of these projectiles averaged about nineteen seconds for about 2,200 yards.

The questions of rapidity of firing and of loading having been determined, the next test was one of accuracy, and the live projectiles were discharged from these guns at a distance of 5,000 yards. The projectiles used were of the eight-inch caliber, the difference in diameter being made up by wooden pistons in four sections, so that the wooden pieces would fly off after the projectiles had left the gun, leaving it clear to make its flight. The first projectile flew 5,000 yards and exploded; the second projectile flew 5,070 yards and exploded; the third projectile flew 5,015 yards and exploded; the fourth projectile flew 5,040 yards and exploded; all of these projectiles being plotted on a plane table in a rectangle seventy yards long by twenty yards wide; the time of flight being about twenty-seven and one-half seconds.

As a matter of experiment, two shots were fired into the hills of Marin county at a distance of 3,550 yards, each with the eight-inch sub-caliber shell, loaded with 100 lbs. of dynamite, the first shot being fired five days previous to the second shot. The shots struck within forty-five yards of each other, and exploded in a perfectly satisfactory manner, in fact the pits caused by the explosion joined each other. The larger shells, viz.: the fifteen-inch full caliber projectiles, being eleven feet long and weighing some 1,050 lbs., loaded with 500 lbs. of nitro-gelatine, were thrown into the sea at a range of an average of 2,100 yards. They exploded practically upon striking the water, throwing into the air a column of water about 100 feet in diameter at the base, and, from the levels taken at the gun, about 400 feet in altitude. The tests as above enumerated were perfectly satisfactory in every respect, and exceeded in every way the requirements of the government. There were no mistakes made and no delays whatever caused by the air compressing plant or the gun plant, which probably exceeded the government requirements in an aggregate of over one thousand per cent., if the various excess percentages of the different tests were added together, and which reflect great credit upon the manufacturers of the power plant, the constructing engineer, the manufacturers of the guns and projectiles, and also the Pneumatic Torpedo and Construction Company of New York, which contracted for and thus successfully carried to completion their contract with the government.

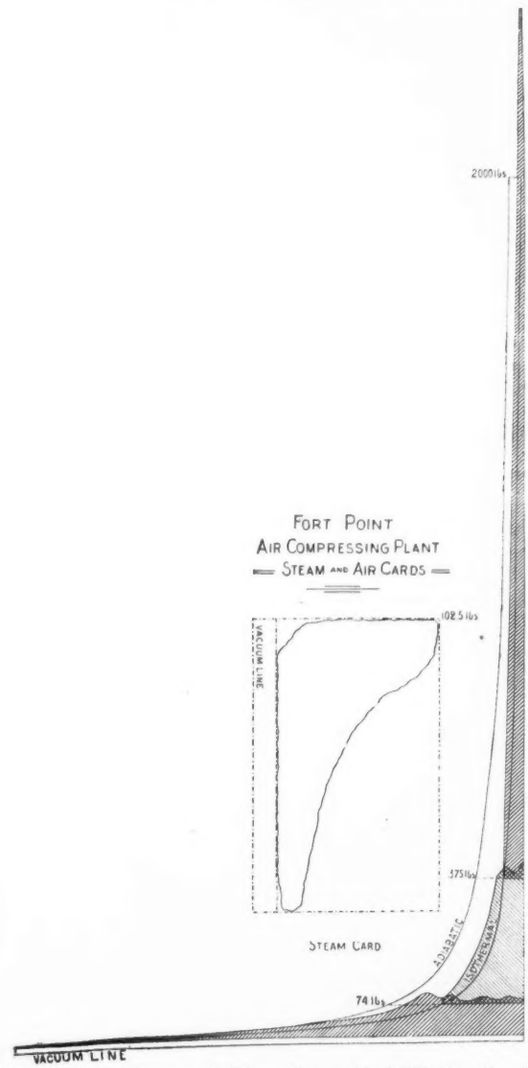


FIGURE 10—*Steam and Three-Stage Air Indicator Cards, plotted from actual cards at 100 r. p. m.*

NOVEL FLYWHEEL CONSTRUCTION.

Among the most recent and novel applications of wire is the wire flywheel lately erected at the Mannesmann Tube Company's works, Germany, and especially notable in view of the well-known fact that heavy flywheels driven at high velocities present such dangers of breaking asunder from the great centrifugal force developed. The wheel at the factory mentioned is described by "Hardware" as a cast-iron hub or boss, to which are attached two steel-plate disks or cheeks, about twenty feet in diameter. The peripheral space between the disks is filled in with some seventy tons of No. 5 steel wire, completely wound around the hub, the tensile resistance thus obtained being found to be far superior to that of any casting. This huge flywheel is driven at a speed of 240 revolutions per minute, or a peripheral velocity of 2.8 miles per minute, or approximately 250 feet per second, which is said to be nearly three times the average speed of any express train in the world. For such a constructed flywheel the length of wire is estimated at about 250 miles.

RECENT SIEMENS-HALSKE INSTALLATIONS.

The Siemens & Halske Electrical Company, since its combination with the Union Iron Works of San Francisco has been effected, has installed several interesting plants, one of the neatest of which is that shown in the accompanying illustrations, reproduced from photographs

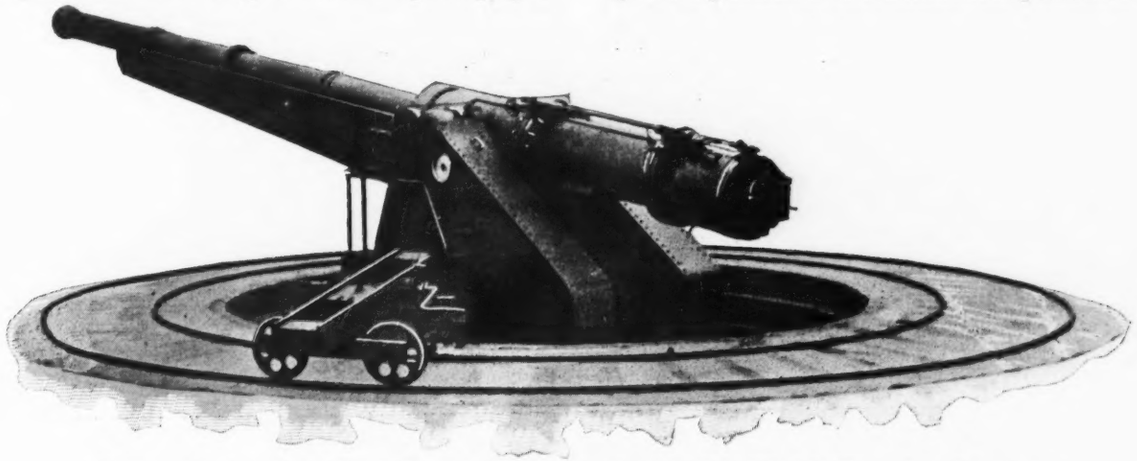
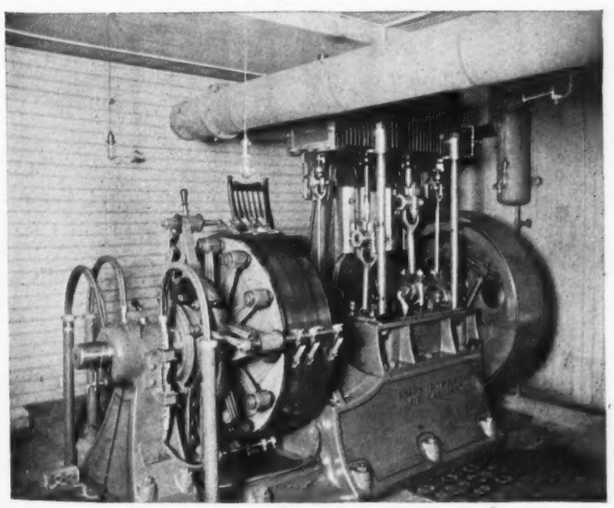


FIGURE 11—*One of the Three Pneumatic Dynamite Guns at Fort Winfield Scott, San Francisco.*

of the lighting plant of the Occidental Hotel, San Francisco. In this installation a fifty KW. 125-volt dynamo is driven direct by a vertical compound engine, having dimensions of nine by seventeen inches by a ten-inch stroke. The engine is of the cruiser type, with special finish, large bearings, and conforms with government specifications throughout, operating at 280 revolutions per minute.

Practical counterparts of this equipment, with the single exception that the dynamos deliver current at a potential of 220 volts, have just been installed in the National Home for Disabled Veteran Soldiers at Santa Monica, Cal. The plant consists of two fifty-five KW. and one twenty-KW. Siemens & Halske dynamos, the former being direct connected machines, while the latter is driven by belting. This installation, which is also



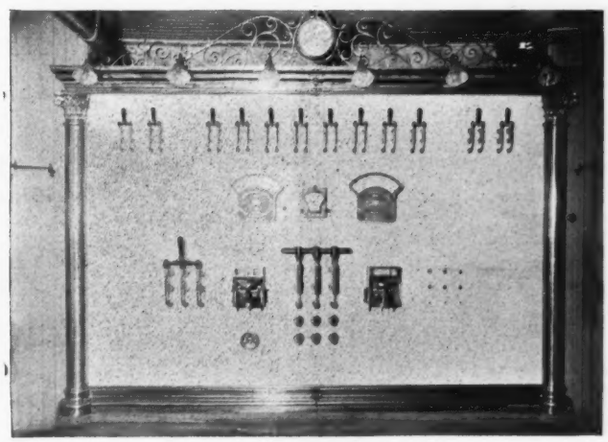
Recent Siemens-Halske Installations.

equipped with twelve Manhattan arc lamps, is noteworthy in that it is the first plant on the Pacific Coast to operate 220-volt incandescent lamps throughout.

The 220-volt incandescent lamps now used are of the Edison and Bryan-Marsh makes, which are undergoing efficiency and life tests.

THE PRODUCTION OF PURE ZINC.

Messrs. Herren-Mylius and Fromm point out that to try to purify zinc by dry methods leads to no favorable results. The wet process can be carried out only with the aid of electrolysis, and this can be done in two ways —by the deposition of the metals from purified solutions with insoluble anodes, or by electrolytic refining with the use of soluble anodes of zinc. In their researches they used pure solutions of sulphate of zinc, and obtained the following results: The pure zinc of commerce contains in all cases noticeable quantities of cadmium, lead and iron. A solution of sulphate of zinc can be purified electrolytically so that chemical analysis cannot find any heavy foreign metals; zinc oxide is easily obtained by a chemical process, with the same purity; the electrolytic zinc obtained from zinc sulphate or oxide contains appreciable quantities of platinum, which comes from the anode; the purest zinc is obtained by the repeated electrolytic reduction of the metal in basic zinc sulphate solutions, from which it is obtained in a spongy state, and must be melted in vacuum. The metal so obtained is not absolutely pure, but contains at least 99.99 per cent. of zinc. With the electrolytic decomposition of zinc, the secondary decomposition of water cannot be prevented entirely.



Recent Siemens-Halske Installations.

——"Allow me to congratulate you upon the varied and interesting matter contained in the last issue of the 'Journal of Electricity.' You are not only getting to the front, but have already got there," writes the president of a prominent concern that has advertised in this paper since its first issue.

FEATURES OF THE PORTLAND TRANSMISSION HITHERTO UNPUBLISHED.

BY GEO. P. LOW.

There has recently been given out for publication in the electrical journals, evidently emanating from the General Electric Company, a well-illustrated article describing the new three-phase transmission plant of the Portland General Electric Company, recently placed in operation between the falls of the Willamette River at Oregon City and Portland, Oregon, which omits to indicate many important features concerning that most interesting installation.

Station B, as the new power house containing the three-phase generators is termed, is located on the west bank of the Willamette River at the falls, and immediately alongside the upper canal of the Willamette Locks and Transportation Company, by means of which steamers are enabled to pass the falls. The station, as far as erected, is of massive concrete construction, and its general design is clearly shown in the outline drawing accompanying (Figure 6). From this it will be seen that both water wheels and generators are of the vertical-shaft type, and owing to the extreme rise and fall of the water in the lower river, sometimes marking an extreme variation of nearly forty feet, it has been necessary to install two sets of turbines for high head and low head, respectively, for each generator, as set forth in the drawing, and more fully described in recent numbers of the electrical press. The generators, which, as stated, are of the three-phase type, each have a capacity of 450 KW. Each contains twenty field poles, is operated at 200 revolutions per minute, and delivers 6,000 volts to the line without the intervention of step-up transformers. The present plant contains but three such units, though it will, when completed, contain twenty similar machines, having an aggregate output of about 13,000 H.P.

In addition to these generators the station contains two multipolar exciters, having a capacity of 250 KW. each. These each contain six poles, and operating at 125 revolutions give 500 volts. These generators, which are over-compounded, have been installed to serve as exciters for the completed station, hence their capacity is greatly in excess of the present demands, and one of them is now being used for operating the three-mile electric railway system that the Portland General Electric Company is running between Oregon City and its manufacturing townsite, Willamette Falls. Here is located about 1,600 acres of land, which is laid out to meet the requirements of a manufacturing city, and to which will be delivered electric power in any quantity desired. Situated as it is, at the junction of the Willamette and Tualatan Rivers, but a short distance above the falls, it is within easy reach of Portland, the commercial center of the Pacific Northwest, and will in all probability soon become the Lynn of that portion of the country. At present the city of Willamette Falls contains probably 800 inhabitants, many of whom find employment in the Capen shoe factory, its solitary industry and which, by the way, is operated by electric power.

From Station B, three three-phase circuits of No. 1 double-braided weather-proof wires are continued, closely following the banks of the Willamette River, over a very substantial pole line to the sub-station in Portland, 14.3 miles distant. The line is supported on two-bell insulators, having an outside diameter of three and one-third inches, which in turn are supported on locust pins placed twelve inches apart. The loss of voltage over these circuits at full load is eleven per cent.

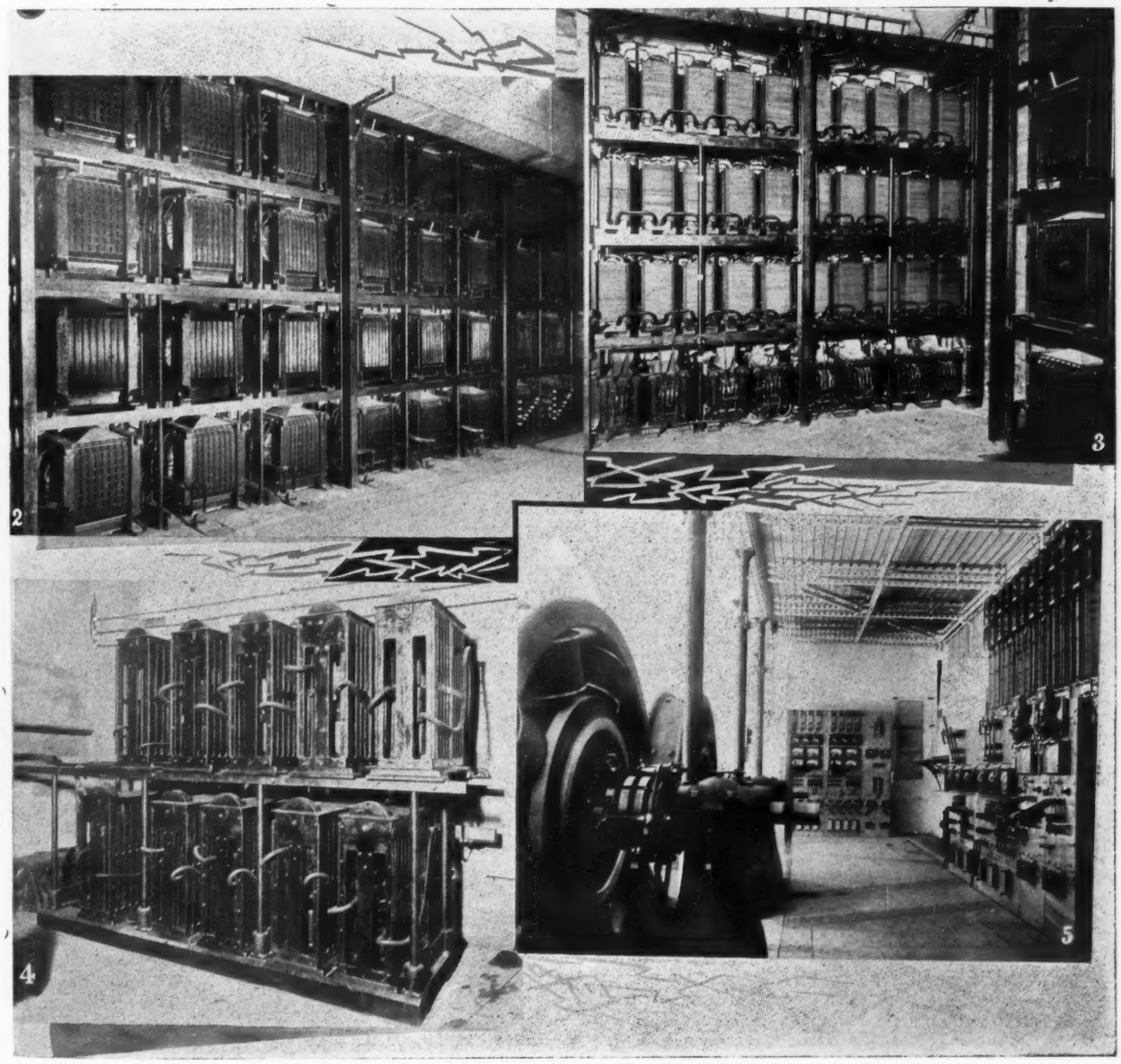
FIGURE 1—*The Falls of the Willamette River at Oregon City, Oregon.*

The particular feature of interest centering in the sub-station at Portland and which has not been heretofore described, is the scheme of distribution for lighting and power circuits. The three-phase current reaches the sub-station at an E.M.F. of approximately 5,500 volts, and is conducted direct to the transformer chambers, where it is fed to three banks of air-blast transformers, shown in the accompanying illustration. As will be seen in Figure 6, each bank of these step-down transformers is arranged in three sets of five transformers each, there being therefore fifteen forty-KW. transformers to each bank, and each bank being operated by a separate dynamo. The first of the banks is used for incandescent lighting direct, and its transformers are wired with the primaries in series across two wires of the three-phase circuit, while its secondaries are coupled in parallel, delivering a simple single-phase current at 133 volts to three circuits on a four-wire system.

The second bank of transformers follows the same connections as to transformer couplings as in the last

instance, with the single exception that the output of the bank at an e. m. f. of 350 volts, which is applied to the operation of the rotary transformers shown in the accompanying illustration. These motor-generators are each of a capacity of 400 kilowatts, and run at a speed of 500 revolutions per minute. They are over-compounded 10 per cent., and deliver an e. m. f. of 500 volts at no load. The direct current thus realized is utilized for electric railway and power purposes.

In the last transformer bank, the primaries of each transformer are each wound for 1,100 volts as in the previous instances, and then coupled in series across two wires of the three-phase circuit, and the secondaries of the transformers, each being wound for 408 volts, are connected in series which deliver a single-phase alternating current at a potential of 2,040 volts, through the switchboard shown in Figure 5, which controls the residence and outlaying districts of the city.



FIGURES 2, 3, 4 AND 5—*The Air Blast and Westinghouse Transformers; the Potential Regulators and the Rotary Transformer and Switchboard Room at the Sub-station, respectively, of the Portland Transmission Plant.*

The first feature to attract attention is that of operating incandescent lamps at the very low periodicity of thirty-three cycles per second, and which is here demonstrated to be practicable, as the satisfactory burning of about 1,000 lamps in the immediate vicinity of the station attests, as no pulsation in the light from the low periodicity is visible. The method of controlling this incandescent service is set forth in the outline drawing (Figure 7), which will be self-explanatory when it is stated that regulation is effected through the use of the potential regulators T, T, T, T, which may be made of either polarity by means of the pole-changing switches S, and then thrown direct into the main circuit either as step-up or step-down transformers, after the manner originally practiced in the Stillwell regulator. The switchboard, which is wired as here outlined, is that shown in the rear in Figure 5, and although a very marked economy in wiring results from this type of four-wire distribution (the circuits being figured at six sixteen C.P. 3.6-watt lamps per ampere), yet the system cannot be considered as entirely satisfactory, owing to its extreme sensitiveness of balance, and it is not probable that the company will extend the installation first made.

The 2,040-volt panel of the lighting switchboard, therefore, gives evidence of experimenting that has not

as yet been prosecuted to a successful issue. As appears further on, the entire City of Portland was lighted by Westinghouse high-frequency apparatus before the installation of the three-phase system, and the scheme outlined in Figure 7 was designed and installed for the purpose of displacing the use of the old apparatus by delivering a single-phase primary potential of suitable voltage, derived from the three-phase system, to the existing lines, but it was soon found that the carrying out of the plan proposed would necessitate throwing out the well-tried and reliable house transformers which had been in long service and the replacing of them with new apparatus, because of the low frequency of the three-phase plant. This involved unnecessary expenditures which the company was not prepared to make, and as the result, at the time of the writer's recent visit to the plant, the 2,040-volt panel was not in use, and it was thought that it would undoubtedly remain a dummy for an indefinite period.

The lighting of the outlaying districts is at present accomplished through the use of the Westinghouse transformers shown in the accompanying group of illustrations, which are supplied with high-frequency current generated by the Westinghouse machines in station A of the company at Oregon City, and which are about to be described, the only difference from the original installation being that, while the primary incandescent circuits in West Portland are run at 1,000 volts as originally

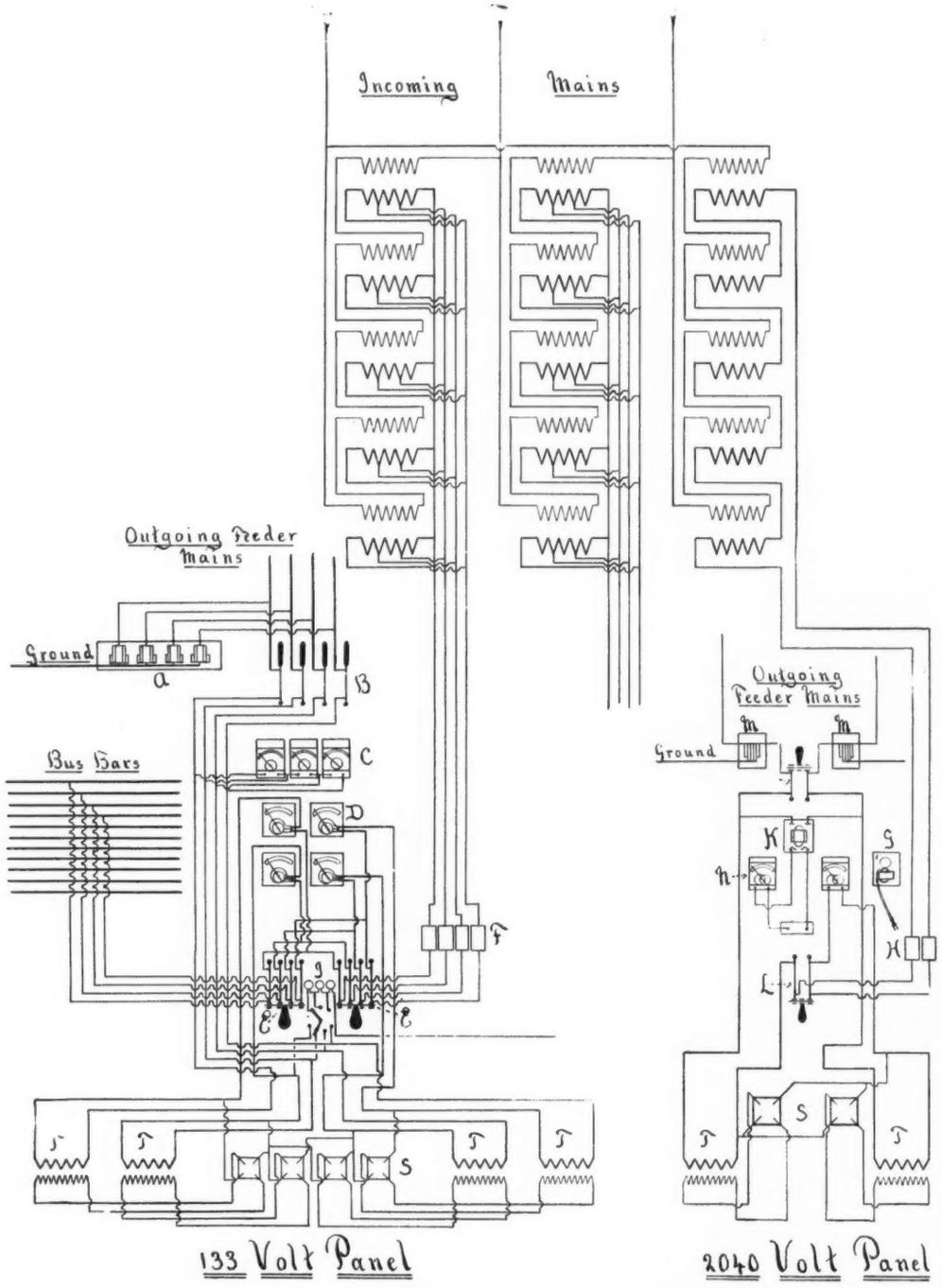


FIGURE 6—CIRCUITS OF THE THREE-PHASE LIGHTING SWITCHBOARD OF THE PORTLAND TRANSMISSION. *A, Lightning Arresters; B, Main Line Switches; C, Voltmeters; D, Ampere-meters; E, Transformer Switches; F, Fuse Blocks; G, Ground Detector; H, Circuit Breaker; I, Lamp Indicator; K, Voltmeter Transformer; L, Transformer Switch; M, Ground-Detector Transformer; N, Voltmeters; S, Pole-changing Switches; T, Potential Regulators.*

installed, those in East Portland are run at a potential of 2,000 volts. The original plant of the company is known as Station A, and is located on the east side of the Willamette River at Oregon City, almost directly opposite the falls and at the steamboat basin. Its electrical equipment consists of eight 1,500 light Westinghouse toothed armature incandescent A.C. dynamos, running at 16,000 A.P.M.; two 120-KW. Thomson-Houston incandescent A.C. dynamos; eleven 100-light Excelsior arc lighting dynamos; one Edison 120-volt D.C. dynamo, used as an exciter for the alternators and for operating the station incandescent lights; one 450-light 120-volt Edison dynamo used as exciter shift; two sixty-KW. and one 100-KW. Edison railway generators and one sixty-five-light Brush arc dynamo, together with two Westinghouse exciters driven by an independent water wheel. The hydraulic equipment in Station A consists of seven 300 H.P. thirty-five-inch Victor vertical turbines, one 250-H.P. thirty-inch Victor horizontal turbine, one 600-H.P. forty-two-inch Victor vertical turbine and one special seventy-five-H.P. fifteen-inch Victor vertical turbine for driving the exciter.

Station A carries the main incandescent load and the entire arc-lighting load of the city, and an interesting feature of municipal lighting is the fact that, in addition to the 600 arc lamps used at street intersections, the darkest streets and those containing thick shade trees are illuminated by twenty-five-C.P. incandescent lamps, 750 of which are utilized, being operated from one 1,500-light Westinghouse alternator.

The Westinghouse installation described in Station A constitutes one of the pioneer lighting transmission plants, and it is yet in such perfectly satisfactory condition that in the marked extensions being made by the company no alterations therein are contemplated. The generators deliver current to the line at a potential of 4,000 volts, which is carried over sixteen miles of double-braided weather-proof wire to the sub-stations at Portland and East Portland, where it is reduced by means of the Westinghouse transformers previously referred to. The two Thomson-Houston alternators in Station A deliver current to banks of step-up transformers for the transmission circuits, the potential being thereby increased from 1,000 volts at the generator to 5,000 volts for transmission. These banks of step-up transformers each consist of series of five converters wound in the ratio of one to one, the primaries being thrown in parallel across the generator, and the secondaries being coupled in a multiple series.

A pole line is run down on each side of the river to the City of Portland, and for the arc circuits four trunk lines and one spare circuit is carried down on the east side from Station A for lighting East Portland, and six arc lines are carried down the west side for lighting West Portland. These circuits are of No. 4 B. & S. gauge double-braided weather-proof wire, the most interesting line being a single No. 4 circuit, almost exactly seventy miles in length and on which are burned ninety-eight 2,000-C.P. arc lamps. This extraordinary circuit is operated from a 100-light Excelsior dynamo, which carries a load of 108 lamps, the line resistance equaling ten lamps. Two hundred arc lamps have been burned experimentally for several consecutive evenings in Portland on a single circuit, operated at over 10,000 volts by two of these Excelsior dynamos in series.

The east-side pole line contains no features of particular interest, but the west-side line, which was rebuilt in September last, contains a conglomeration of circuits that make it noteworthy. It consists of fifty-foot poles, having a diameter of twelve inches at the top and varying in diameter from twenty inches to twenty-four inches at the butt, the poles being placed 100 feet apart. The poles erected in the country division contain three six-pin crossarms and three eight-pin crossarms, giving, therefore, a total of forty-two pins, and on these are run the following circuits:

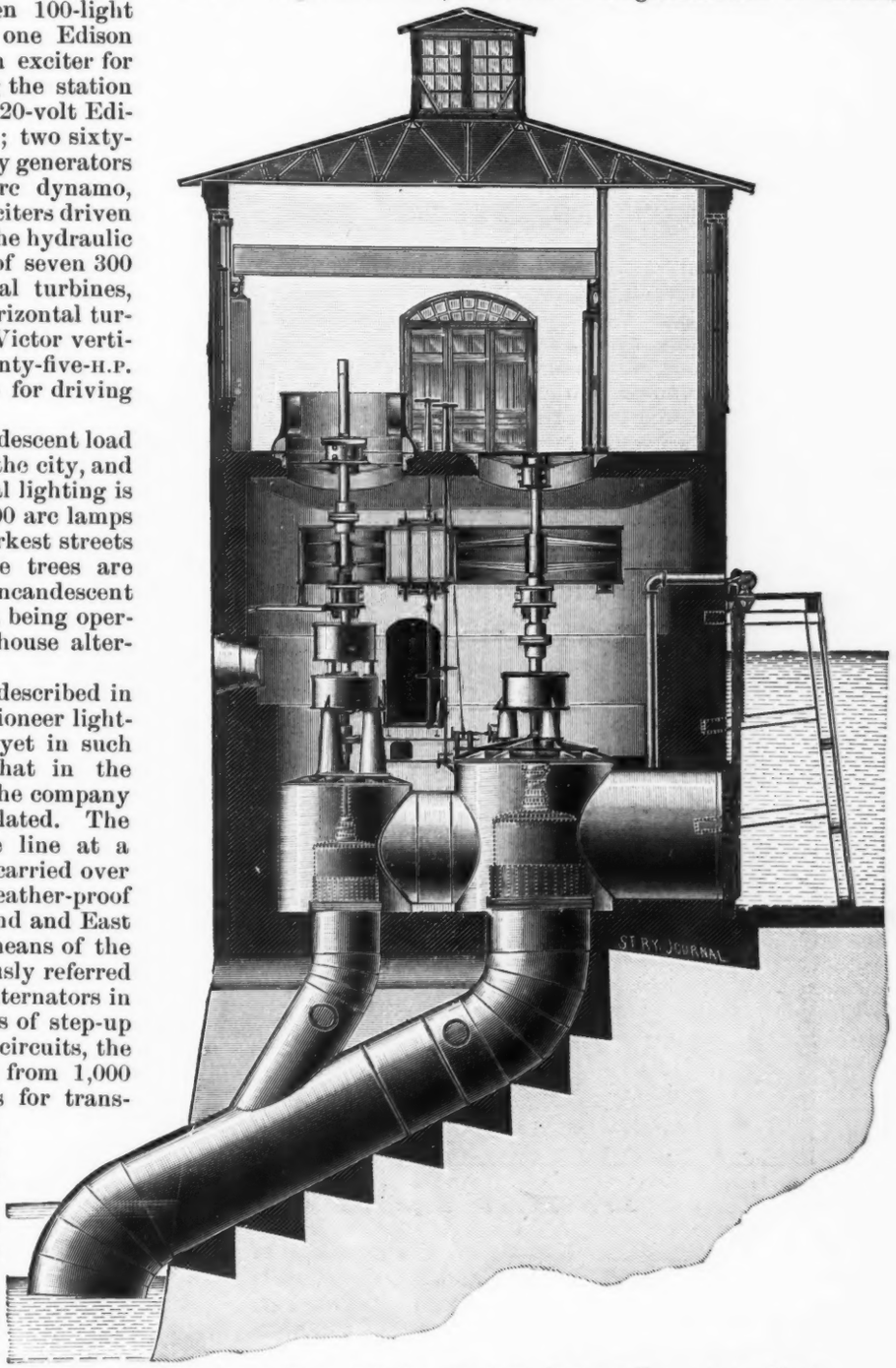


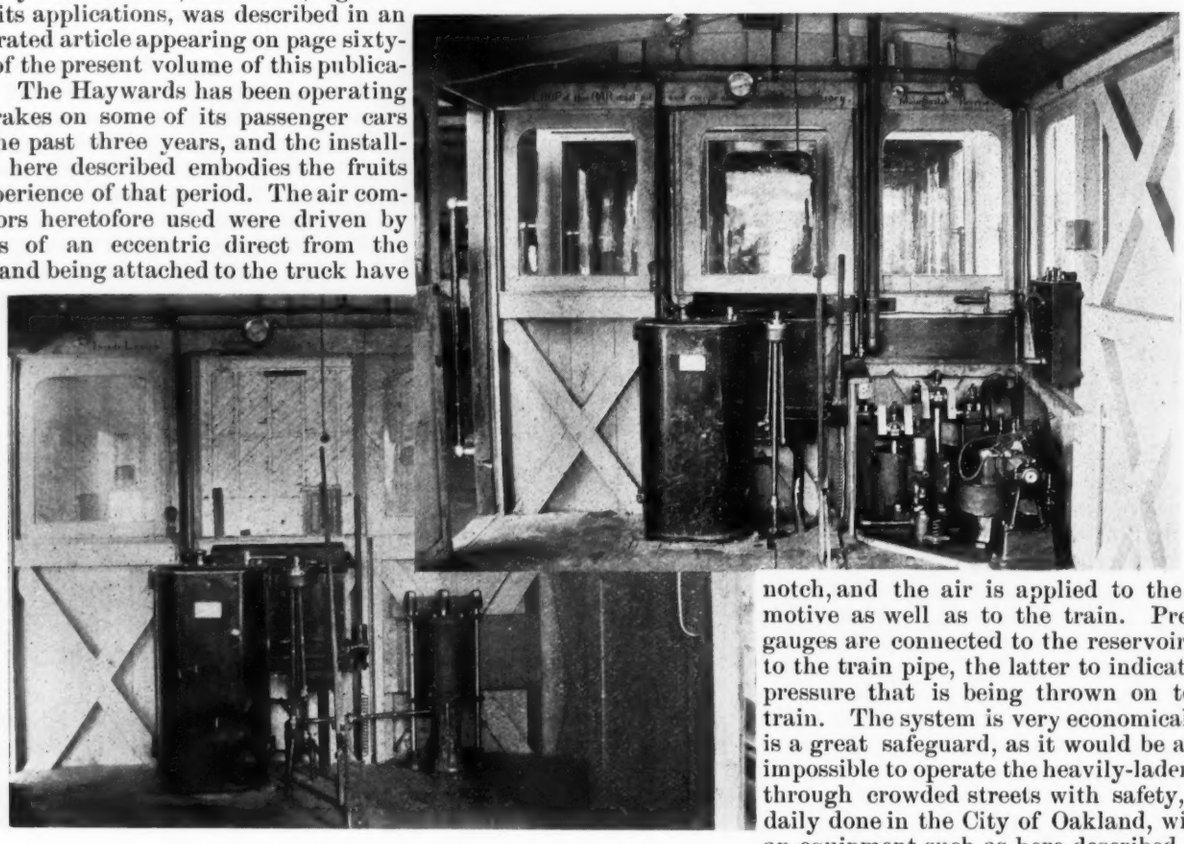
FIGURE 7—*Sectional View of Station B, of the Portland Transmission Plant.*

Seven 4,000-volt incandescent circuits No. 4 wire; six arc circuits of No. 4 wire; two three-phase circuits of No. 1 wire; one six-conductor Okonite telephone cable; one galvanized iron linemen's call-bell circuit; one copper signal circuit, a total of thirty-six wires.

Communication between the attendants at the substation and at the generating station is effected by means of signals rung in on vibrating bells. In addition telephonic communication is carried on with ease over the cable above referred to, which, as stated, is strung along the transmission line. Considerable interesting experience has been derived in this installation in connection with telephoning over lines submitted to heavy induction, and which will be fully described in an early issue of this publication.

AIR BRAKES ON THE HAYWARDS LINE.

The accompanying illustrations present views of the interior of the electric locomotive in use on the main line of the Oakland, San Leandro and Haywards Electric Railway Consolidated, and which, together with its applications, was described in an illustrated article appearing on page sixty-nine of the present volume of this publication. The Haywards has been operating air brakes on some of its passenger cars for the past three years, and the installation here described embodies the fruits of experience of that period. The air compressors heretofore used were driven by means of an eccentric direct from the axle, and being attached to the truck have never given satisfaction, because of the exposure of the working parts and of the dust and the dirt that is constantly being set in motion by the moving of the car. It became apparent during the construction of this electric locomotive that air brakes would be necessary to the handling of the heavily laden flat and coal cars, and, accordingly, Mr. C. Gustafson, then Master Mechanic but now General Manager of the road, designed and installed the air brake plant described.



Air Brakes on the Haywards Line.

The pump consists of duplex single-acting cylinders having a diameter of five and three-quarter inches by five-inch stroke, which is connected with a crank shaft driven in turn by a two-horse-power 500-volt motor as shown in the illustration. This motor, which was built by the Electrical Engineering Co. of San Francisco, runs at 2250 revolutions per minute, and is connected to the crank shaft by a worm gear, which reduces the speed of the pump to forty revolutions per minute. The equipment is mounted on a single baseplate, and is of such mechanical construction that there is nothing about it to get out of order. The plant has been in constant use for the past eight months, during which time it has given perfect satisfaction, and it is no venture to express the belief that it will run for years without expense other than that for oil and brushes.

The air reservoirs are placed inside of the locomotive under the ceiling, and are of wrought iron piping having a diameter of two feet eight inches, and being fourteen feet long. The air pressure is carried at about forty pounds. The jam cylinders are also placed in the car as shown in the cut, and, in addition to the locomotive, all flat and coal cars are equipped with jam cylinders. The controller valve is so constructed as to apply the air to the train first. In ordinary stops this is quite sufficient, but, if a very quick stop is necessary, the motor-man simply throws the lever to the next notch, and the air is applied to the locomotive as well as to the train. Pressure gauges are connected to the reservoirs and to the train pipe, the latter to indicate the pressure that is being thrown on to the train. The system is very economical, and is a great safeguard, as it would be almost impossible to operate the heavily-laden cars through crowded streets with safety, as is daily done in the City of Oakland, without an equipment such as here described.

ELECTRICITY FOR GRAIN HAULAGE.

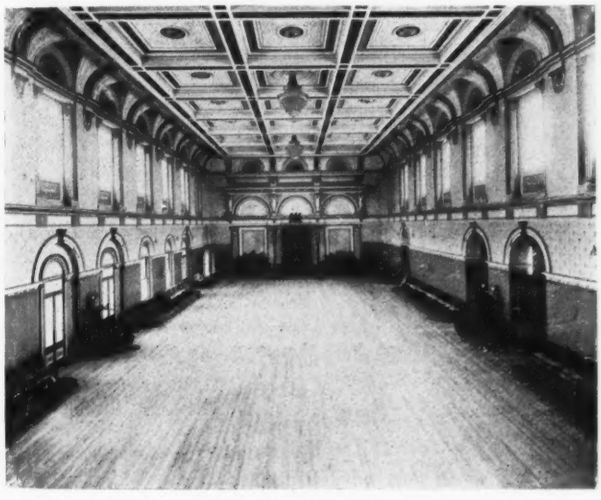
An electric freight car operated by the ordinary overhead trolley system is being operated in Spokane, Wash., by the "C. & C." Flouring Mills, owned by the Washington Water Power Co., and which have recently been leased to the Portland (Or.) Flouring Mills Co. This freight or grain car, which runs regularly between the "C. & C." mills and the railway station, displacing the drays formerly used, was specially built for the service. It is twenty feet long, and the grain compartment is twelve feet long, six feet wide and five feet six inches high, with a capacity of 12,000 pounds, or 200 bushels of wheat. At the freight station, the floor, which is hinged and carries a steel hopper, is raised, and the car is loaded

with grain from the main line cars. On reaching the mill the car is run over a chute, the gate of the hopper is opened, and the grain is dumped. The floor is then let down to cover the hopper, and the car is loaded with bags or barrels of flour to go to the railway station. Whenever the streets along the line require macadamizing, the car is used for carrying and discharging the broken stone.

PHOTOGRAPHY BY GLOW LAMPS.

By W. Lodian.

I have chanced to see in this far-off country a copy of The Journal of Electricity for October, containing the excellent and beautifully illustrated article by Messrs. Mullander & Sprout on "Night Photography by the Electric Light," which recalls the fact that among the writer's batch of electrical curios, collected during a recent six months' tour through Australasia, is the accompanying photograph of the largest private ball-room in the State of Melburnia. The view, which was taken by Theodore O'Shea, a leading photographer of Melbourne, and presented to the writer, is interesting in that it is



Photography by Glow Lamps.

the first one taken by the aid of incandescent lighting exclusively in the southern hemisphere. Considering the circumstances, the picture has turned out to be first-class in every regard.

It was a moonlight night, and the view was taken a short time prior to the opening of a ball. An exposure of twenty minutes was given, a four by five plate being used. The cleverness of the photographic printer came in in so retouching the negative as to remove the blurred appearance surrounding each incandescent light. So neatly was this done that, when the present photograph was placed side by side with a daylight taken photograph in the recent photographic exposition at Melbourne, the difference between the two could not be detected. In truth, the picture is a remarkable example of electrical photography, as no magnesium light or illuminant other than the glow lamps in the room was used.

Calcutta, India.

THE A. I. E. E. IN SAN FRANCISCO.

The first meeting for the winter of the Pacific Coast members of the American Institute of Electrical Engineers was called on Saturday night, November 30th, at the request of the secretary of the institute, in order to combine with the meetings in New York and Chicago for the topical discussions on the present status of the storage battery question. This meeting is notable as being the first held on the Pacific Coast with regular officials of the institute in attendance, the recently elected vice-president being in the chair, and the local secretary officiating as secretary of the meeting.

After a pleasant dinner at Frank's rotisserie, where, in addition to the regular members, such prominent guests as Professor Davidson of the Coast Survey, W. S. Hager of the Westinghouse Company, and W. C. Swain, chief operator of the Postal Telegraph Company, were in attendance, the business meeting was called to order and the principal speaker, Mr. E. J. Molera, was introduced. After a review of the early history of the storage battery invention, Mr. Molera proceeded to give an account of his own early experiments in storage battery manufacture and accumulator traction, exhibiting the first Plante storage battery cell imported into this country, together with a cell and switches from the first accumulator car ever run, which had been operated by Mr. Molera in the City of San Francisco in the year 1882. After this important communication from Mr. Molera had been received, the local secretary gave extracts from the papers presented before the institute in New York by Professor Carhart and Mr. Arthur E. Childs, and then showed to the members load curves obtained from the San Jose Street Railroad and the Electric Light Company of the same city, indicating the greater importance of the storage battery in the average street railroad station than in a similar lighting supply station. Following this communication Mr. Hager explained to the members the investigations he had made on the applicability of the storage battery supplying power for the electric railroad system of the City of Wilmington, Del., and stated in conclusion that he considered, even with the present high cost for accumulators, that they were undoubtedly the cheapest means for supplementing the generating apparatus on any electric railroad, provided that the batteries were installed for the purpose of carrying simply the peaks of the curve and being operated at the time of their maximum load considerably above their rated capacity, which, in Mr. Hager's opinion, was a justifiable use of well-made storage batteries, an opinion derived from an extensive investigation of well established plants.

At the conclusion of this communication the meeting was adjourned after the appointing of an Executive Committee, consisting of E. J. Molera, F. F. Barbour and Professor Clarence L. Cory, with instructions to confer with the local secretary and formulate a plan for continuing the meetings throughout the winter.

PERSONAL.

Mr. Frank X. Cicott, Manager of Billings & Spencer, of Hartford, Conn., has been traveling over the coast in the interests of his firm.

Mr. C. S. Knight has returned East after having established a Pacific Coast office of the Fort Wayne Electric Corporation in San Francisco.

Mr. O. S. Lyford, Jr., Chief Engineer of the Siemens-Halske Electric Company of America, has gone back to Chicago, but is expected to return to San Francisco shortly.

Mr. H. S. Clark, of the Westinghouse Electric and Manufacturing Co., has been ordered from the San Francisco office to Pittsburg, where he will engage in special testing work at the factory.

The Journal of Electricity.

An Illustrated Review of the Industrial Applications of Electricity, Gas and Power.

EDITED BY

F. A. C. PERRINE, D. Sc., and GEO. P. LOW.

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A PLEA FOR MOTORMEM.

In the "Electrical Engineer" for November 13th we note an article signed "A. F. D." on "A Plea for Motormen," which is recommended to the careful consideration of every electric railroad manager. In this article the author calls attention to the fact that, while honesty and integrity are undoubtedly necessary requirements for a satisfactory motorman, an amount of electrical knowledge beyond that possessed would increase his efficiency as a handler of the electrical machinery placed in his charge.

One of the papers before the Montreal Convention impresses this in citing a test made upon an electric railroad by taking wattmeter readings when the car was run by a first-class motorman, and afterwards run by an electrical engineer understanding the principles of the controller. The difference in the total amount of power employed amounted to as much as twenty per cent. in favor of the engineer. In many cases it is not possible for street railroads to maintain a school for the instruction of their employees, but it is always possible for the street railroad to employ the motormen upon the waiting list as repairers and helpers in the car shed. In this department they would unfailingly gain an acquaintance with the construction of the motors, method of wiring cars, and the principles of the controller which would enable them to understand the importance of the rules issued to them for instructions in operation. Such a course of instruction would raise the tone of the men at the brake handle by making them feel themselves more nearly upon the level of the locomotive engineer. The article we are discussing mentions the fact that, in steam railroads, managers have found that it pays to post in their roundhouses honor rolls showing the record in running and the consumption of material of each engineer; but though the electric railroad motorman can materially alter the consumption of coal at the central station by his handling of the controller lever, no attempt is made to distinguish between careful and intelligent workmen and those who simply carry their car over the line without regard to the apparatus on the car or the amount of power used. With the introduction of high speed working in electric tram lines has come the liability of accidents from obstructions on the track, which can only be diminished by a corresponding education of the motorman, and a rise in his character as a workman, which will undoubtedly come about whenever the managers appreciate the fact that his efficiency will be increased through careful instruction.

AIR TRANSMISSION AT HIGH PRESSURES.

It is gratifying to learn that the experiments made at the Presidio upon the Rix compressed air apparatus built by the Fulton Engineering Works have proved to be eminently successful, and the fact that there is in this country an engineer capable of designing efficient compressed air apparatus will do more to advance this system of power transmission than the experience derived from the low pressure systems which have been installed in Paris and in England. The distribution of power by the means of compressed air was suggested to the promoters of the Niagara Power Company, but at the time the only system of compressed air distribution sufficiently extensive for comparison was that of Popp, in Paris, which uses a maximum pressure of 200 pounds and distributes at a maximum distance of 10 miles through large mains running up to 30 inches in diameter. While the transmission losses are undoubtedly small in this distribution, still the leakage is great enough to reduce the efficiency of the entire system to about 38%. Using higher pressures up to 2000 pounds, which Mr. Rix's apparatus has demonstrated to be practicable, General Hermann Haupt estimates that 2,500 horse-power may be transmitted one hundred miles with an initial cost of plant below $750,000, and a total yearly cost for power delivered not greatly in excess of $13.00 per horse-power. At the present time there are too many problems remaining unsolved connected with power distribution through the medium of air, at 2000 pounds, for any one to be able to state whether these figures are entirely accurate or not, but we have here already solved the problem of initial compression, and we may expect this achievement to be followed step by step by solutions of the various transmission problems and other problems connected with high pressure air distribution. Surely the engineering successes attained will not be allowed to remain much longer unused, in the face of the great long distance power transmissions now constantly being brought up for solution.

ELECTRICITY IN OFFICE PRACTICE.

Before the Fresno County Medical Society, Dr. W. N. Sherman, of Merced, Cal., has recently presented an extremely interesting paper upon the subject of "Electricity in Office Practice." The advance of electro-therapeutics has, during many past years, been greatly hindered by charlatans and quacks who have seized upon the mystical character of electric action in order to dupe their patients into the purchase of electropoises, electric belts, towels and hundreds of similar impositions. During all this time, however, certain conscientious doctors have labored

earnestly to understand the action of electricity upon the human body, and, with the aid of apparatus designed by D'Arsonval and Charcot, in France, and by Kennelly and Morton in this country, their investigations have proved that not only does the application of electricity itself have certain distinct effects upon the muscles, tissues and nerves, but also by the means of electricity well-known medicines may be introduced into the system in such a manner as to effect a maximum amount of benefit. The latter application, while newer than the treatment by electric shocks and baths, appeals more to the intelligent electrician. Not only is electric cautery produced by incandescent platinum wires, but also by the local formation of caustics through the medium of electrolysis decomposing the salt solutions contained within the body itself. Using soluble anodes, the physicians have been enabled to apply the highly antiseptic hydrochlorites of copper, zinc and iron directly to the tenderest mucous membranes, and effect cures in catarrhal diseases which have heretofore obstinately evaded treatment.

By the means of cataphoresis, which is the name for osmotic transference of liquids by an electric current, it has been found possible to introduce into any point of the system many liquid medical agents, such as chloroform, quinine, iodine, etc., and to produce exceedingly effective local anæsthetic and medical actions upon the blood without disturbance of the digestive organs, which has accounted for many of the evil after effects of these curative agents.

In nervous diseases Dr. S. Weir Mitchell has been able to obtain effects similar to massage and to strengthen the tissues of a nervous patient by the means of an agent disassociated from the common repugnance to drugs and consequent mental disturbances. All of these methods for treatment have placed the science of electro-therapeutics upon a sound footing both in the minds of the members of the medical profession and of those familiar with the phenomena of electricity. At the present time in medicine the treatment of disease by the means of drugs has given place largely to surgical treatment, though the attendant injuries are often serious in such practice, and we may hope that the advance now taking place in electro-therapeutics will be able to re-introduce the earlier method and to make it more efficient than ever before.

SCHOOLS FOR ENGINEERING EDUCATION.

The enormous extension in schools throughout the world for teaching the technical professions has opened many questions concerning the conduct of such schools and the requirements for both instructors and scholars. Fifteen years ago such schools existed only for the education of civil and mechanical engineers, while the general tendency was to consider them as minor departments of the academical colleges; but at the present time we find that instruction is given in all branches of engineering knowledge, and that the students in attendance rival, in numbers at any rate, those in the academical courses. In face of the great increase in the number of students in all branches at the various seats of learning, it is difficult to decide whether this increase in the engineering schools has been due to a falling off amongst those desiring a general education or whether it has been due to the acquirement of engineering knowledge by those whose time and tastes would not permit of their attendance upon any other course. If the last is to be considered as the true explanation of the expansion of the engineering schools, it is fortunate that any course of instruction has been devised which will tempt busy men to increase their stock of theoretical knowledge; but if the graduates of engineering courses are to be considered in the future as completely educated men, there is danger that not only will the literary departments suffer, but also that the sciences will lack men furnished for their advancement. Such a danger is due rather to the conduct of the schools by the teachers than to the character of the scholars themselves. Every scholar forms much character and wit from his contact with a respected teacher, and if that teacher impresses upon him the worth of learning he will become enthusiastic for the advancement of learning; but if the teacher spends his own time and that of his scholars in the solution of problems for gaining money solely, there is little danger that the practical men of the next generation will complain that the student is less sharp and unscrupulous than the unlearned business man. In some schools the laboratories are furnished solely with a view of performing tests and for the students to become familiar with the methods applicable to the understanding of money-making problems. Some of our professors, even, are engaged and commonly employ their students as draughtsmen and designers in the manufacturing business, without regard to the value of their work when viewed as knowledge. No complaint can be made of any man who desires to keep thoroughly in touch with the practical advances of the knowledge of the world, nor should the teacher hesitate to give advice based upon his knowledge and experience to those undertaking practical problems, but when the instructor enters into manufacturing competition which necessitates for success that he should conceal from other manufacturers the most important advance he is capable of making in his profession, he encourages a system of concealment of knowledge which is unfortunately too prevalent throughout business, and which only a teacher is capable of counteracting. It seems strange, when we consider the teachers of the last generation were blamed for retiring within themselves, that the recent introduction of technical schools has changed the conditions so greatly that such a warning can be issued, but it is an unfortunate fact that some of our engineering professors are apparently aiming more at their own personal advancement than at the preparation of their students for the duties of life and a high-principled citizenship, which should be the safeguard of our civilization.

Passing Comment.

AN EDITORIAL REVIEW OF CURRENT EVENTS AND PUBLICATIONS OF OUR CONTEMPORARIES.

There is an heretofore unpublished anecdote concerning a now much discussed English professor's early visits to this country in connection with the Niagara power transmission, which may throw a sidelight upon his published acquaintance with the people of wealth and fashion upon this side of the water. We have the story from the professor's unfortunate host. On one of his visits to a city within a night's ride of New York, accompanied by his famous meter, which he was trying to sell, the professor asked some legal advice of a gentleman high in social and literary circles in the city where he was visiting, and to whom he had the usual letters of introduction from the London friends of the American. In the midst of his legal inquiries the professor incidentally mentioned that he desired to have his presence in the city unknown to the electrical and newspaper men, and, on the hint, was taken to his legal adviser's country home, where he was handsomely entertained until his business was completed. After waiting a sufficient period of time his host casually submitted a moderate bill for his legal advice to the professor, and though some year or more had elapsed at the time this story was told, nothing more had been heard from the eminent engineer, though his companion on the visit, the energy meter, was reposing in his host's strong box for safe keeping against the time when it should be sought after by all American manufacturers and distributors of electrical current.

Whether other acquaintances were made by the courteous professor, during his many visits to this country, in the same manner, is not known, though it is hardly believed that the methods used would be often indulged in by our cheeky American engineers when visiting either at home or abroad.

Of all the tributes that have been printed to the memory of the late Franklin Leonard Pope, there is no one that appeals to the mind of the engineer so greatly as the unfinished article of Mr. Pope contained in the December number of the "Engineering Magazine" on "The Distribution of Electrical Power at Niagara," an article filled with references to the various plans for power distribution which have been proposed, in which in every case the vigorous mind has passed upon the salient and important points, presenting the advantages and disadvantages attached to each of the various systems clearly and intelligently. This article from the master hand is in striking contrast with the one in the same journal calling for our criticism last month, and it is with the utmost regret that we read the portion written, and try to imagine what Mr. Pope's introduction was to bring out in his mature conclusion. In the pages written by his brother, Mr. Ralph Wainwright Pope, at the end of the article the oft repeated story is touched upon of the great fund of experience of Franklin Pope's life and the failures and successes of many water power schemes with which he was familiar, and here we are compelled to pause and wonder whether some of the great electric transmissions in which we know he took so much pride may not be adding other chapters to this history of financial rashness. With every development of cheap power and cheap power transmission, engineers have dreamed far into the future of a rehabilitated world, but always we are compelled to come back to the conclusion that no mechanical or scientific advance can be a "cure all," though each piece of work well done is worth doing, even though it but leads to better methods of solving the same problems in a large way.

During the past month, in the "Electrical World" and in many contemporary journals, descriptions have been printed of the various conduit electric railway systems used in Washington and New York. Several of the papers have taken up the cudgels in favor of such electric railroads against our familiar friend, the overhead trolley, as well as against cable transmission systems. It is even stated that the officials of the Illinois Central and other standard steam roads are awaiting the results of experiments on this underground construction before undertaking the use of electricity upon their lines. "Electricity" alone, of all the papers, is distinctly hostile to this means of construction, and if the figures of cost which "Electricity" presents approach the truth, there certainly remains much to be done before the conduit system may be considered a financial success, even, though the engineering problems may be regarded as solved. It is stated that the Lenox avenue road in New York costs for conduit construction and sudsidiary sewers as much as $175,000 per mile, and if this statement is true, the amount of power saved by electric traction can hardly compensate for the cost above even the cable system. Reports from Minneapolis and St. Paul indicate that the cost of the maintenance of underground feeders has been found to be excessive in these cities, and that the very complete underground feeding system, which was originally installed, has given place to an overhead feeding system, which certainly would lead us to suspect the success of any conduit in a similar location. The feeders in Philadelphia and Boston are now being placed underground, and if they are found to operate successfully the next step may be taken towards burying the trolley, though until it is proved that the feeders may be economically maintained in underground conduits we can hardly attempt with safety the use of a complete underground electric railroad system.

In an article in the "Electrical Engineer" of Nov. 20, James Pass writes upon the durability of porcelain as an insulator; a subject which we do not remember to have seen discussed in any American electrical paper before this time, though the English journals have devoted a good deal of attention to the subject. The pottery materials which have been used for electrical insulation are divided into two general classes. First, those in which the pottery itself is the insulator, and secondly, those in which the insulation is provided by a glaze, the last material being called stoneware and the first porcelain. Stoneware has been used for many years in European construction for line insulators, and we hear that under certain conditions the salt glaze has been reduced to sodium by electrolytic action and has been the cause of conduit explosions. This difficulty requires such special conditions that it is hardly to be taken into account in any installation, though it is unfortunately a fact that when the glaze is broken away from stoneware the biscuit is so porous in character that it will very readily absorb a large amount of moisture and cannot be relied upon as an insulation. The material more generally used throughout this country is a porcelain thoroughly vitrified throughout its entire body, glaze being applied only for appearance. We notice with regret that certain supply houses are now advertising floor tubes and switch bases made of stoneware, and we may expect that this construction will soon be charged with furnishing a new cause for mysterious fires, unless the insurance inspectors will forbid its use before such accidents take place. While porcelain is more ex-

pensive in first cost, it has the property of being moldable into any definite shape and with such accuracy that metallic pieces may be fitted to porcelain bases and made interchangeable, while the material of itself is such a perfect insulator that the presence or condition of the glaze applied will influence the protection it affords but slightly. The growing use of an inferior material demands the increased amount of information concerning the properties of porcelain, and we hope that the information published by Mr. Pass may lead to a larger general knowledge on this subject.

The too often occurrence of severe accidents from bursting fly wheels, which sometimes are of such seriousness as not only to wreck entire stations but to cause the loss of many lives, has led to a very general discussion of the subject in the engineering papers, and it seems that a successful solution of the problem may be had in the interesting wheel designed by Edw. S. Cobb, M.E., and in the air-compressor plant of the North Star Mining Company at Grass Valley, Cal. This wheel, which was fully described in the November issue, presents a radical departure from the ordinary type of fly wheel particularly in that it is a trussed wheel. It is 18 feet in diameter, and is working at the normal rate of 110 revolutions per minute, which gives it a peripheral velocity of upward of 6200 feet per minute. The wheel has, however, been driven, under test, at the peripheral speed of over 7350 feet per minute, which condition, although unusual and excessively severe, was withstood without strain. It is noteworthy, moreover, that the cost of building this wheel was some $300 less than the cost of building a similar wheel by the more familiar methods, and the fact that it is operating to perfect satisfaction under stringent conditions would seem to indicate that the mechanical world should find in it a means of eliminating one of the most potent causes for accident that add peril to the use of high speed machinery.

One does not expect a great amount of technical ability to be displayed by the editor of a daily paper, though it is surprising when an editor shows a decided lack of common sense in discussing engineering problems. Possibly the San Francisco dailies, in their blind hatred toward the Southern Pacific Company, grasp at any scheme capable of proving that the railroad managers absolutely disregard the comfort of their passengers; but when we find half a column of the editorial page devoted to the old scheme of train-lighting by the means of storage batteries charged from dynamos placed upon the car axles, one is sufficiently surprised without finding in the same article that the editor seems to allow the claim of the promoters that the power for driving the generators so attached is the same as the power formerly lost in friction at the journals of the cars. That journal friction should be decreased by placing an additional burden upon the axles is an axiomatic engineering impossibility, and one would think that the editor of so able a paper as the "Examiner" would, in the interest of his own reputation for common sense, refuse the admission of such claims, even though he was capable of disregarding the misleading effect that any such an article might have upon intending investors.

Within a short time we will have an opportunity to examine the applicability of the Boynton bicycle railway system to light haulage. It is promised that within two months work will be begun upon a line from San Mateo to Pescadero, to be constructed upon this plan and operated by electricity presumably provided by the water-power of the Pescadero Creek. This line will give access to an attractive part of the sea coast much nearer San Francisco than either Santa Cruz or Monterey, while locally it will give access to a large amount of ranch and forest land, which has hitherto been almost inaccessible on account of the heavy roads over the hills between the country lying along the Coast and the Coast Division of the Southern Pacific Company. It is stated that the Boynton system has been adopted on account of the heavy cuts, fills and grades, which would have presented engineering difficulties to the construction of a standard roadbed. In spite of the fact that the road proposed is to be very winding, and to escape most of the heavy grades, still the grades that will be encountered are sufficient to tax the engineering skill of the projectors very highly, and to give a severe test to the economy of the system.

Whatever may be our prejudices for or against this system, which provides one rail under the car and one rail over it, we read in the attempt to install such a line a clear understanding of the demand for light railroads capable of serving as feeders for the standard lines; and whether the light railroad of the future will be a standard electric tram line, the Lamb suspended cable system or the Boynton bicycle railway, there will undoubtedly be much construction of such light roads in the future with the consequent opening up to home seekers of a vast extent of territory hitherto inaccessible.

Not only the daily press, but a number of the electrical journals have been greatly concerned with the report that John Jacob Astor has invested heavily in the stock of the Keely Motor Company, fears being expressed that many investors will be induced to lose money in this scheme through the influence of so eminent a moneyed man as Mr. Astor. Supposing that the report be true of Mr. Astor's investment, the scientific investigations that from time to time have been made upon Keely's scheme should surely prove of greater weight than the opinion of this member of the Astor family, especially since the Astors have not for many years maintained a reputation for shrewdness in investments outside of the real estate line. It is true that the Keely motor has never been openly and completely investigated, but it is equally true that the effects shown by Keely have been universally judged to be no more than equivalent to those which might be obtained with compressed air. Keely's experiments at Sandy Hook with his etheric gun were a flat failure, while the construction of the apparatus, method of loading and firing the gun, and in fact all of the details of the experiments pointed to a compressed air plant. At one time when Mr. Keely was declaiming upon the immeasurable pressure exerted by his force, Captain Zalinsky modestly requested that the force be applied to smash a recently tested 80,000-pound gauge which he happened to have with him at the time, though, of course, the test was refused by Mr. Keely.

Among those who have examined this motor and have reported that there is nothing unprecedented in its action, electrical men will have confidence in both Professor Elihu Thomson and T. Carpenter Smith, not to mention other electricians of less note and clearness of mind who have reported unfavorably to the scheme. If, in face of the unfavorable scientific reports that have been made on Keely's invention and of the doubtful business methods that have been indulged in by this company, there are still to be found investors who will follow the lead of John Jacob Astor, they can only be considered in the light of the dupes of a confidence man who are only defrauded by reason of their own desire to overreach someone else.

Electro-Insurance.

THE MEETING OF THE ELECTRICAL COMMITTEE OF THE U. N. E. A.

A well-attended meeting of the Electrical Committee of the Underwriters' National Electric Association was held at the rooms of the National Board of Fire Underwriters in New York City on Tuesday, Wednesday and Thursday, December 10th, 11th and 12th.

As the work of the Electrical Committee of this Association has now become generally recognized throughout the United States by the various boards of Fire Underwriters, which have adopted the rules as recommended by the Committee, and as quite a number of cities have also incorporated, these rules in their City Ordinances regulating the introduction and maintenance of electric light and power wiring, it may be of interest to give a brief sketch of the formation of the Association and its Electrical Committee.

In the summer of 1892 the Secretary of the New England Insurance Exchange, after correspondence with the Electrical Inspectors of the Underwriters' Association in the East, called a meeting of the electrical representatives of the various Eastern Associations for August 18th at the rooms of the National Board, in New York. This meeting was called without any specially prepared plan of action, and it was not felt advisable to ask for representatives from boards situated at a distance from New York City. The meeting, however, was more of a success than was even hoped for. The rules as adopted by the National Electric Light Association were taken as a basis and carefully considered and revised, section by section. Proofs of the revised rules were sent to all the underwriters' organizations in the United States, with notice that a second meeting would be held in New York City, and with request that any suggestions in relation to the rules be sent to the chairman of the meeting. These organizations were also advised that a plan for a permanent organization of the electrical representatives of the underwriters would be presented at the meeting, and all were requested to send representatives to that meeting, which was held on December 6th of the same year.

At the December meeting a permanent organization was formed, called the "Underwriters' International Electric Association." At a later date the name was changed to "The Underwriters' National Electric Association."

The articles of association, which have only been slightly changed since their adoption at this meeting, provide, "that any member, officer or employee of any fire underwriters' organization or fire insurance company in the United States or Canada, may become a member of the association on application to the Secretary." The officers of the association are a President, Vice-President, and Secretary and Treasurer. The articles of association also provide for an Executive Committee and an Electrical Committee, the last named to consist of nine members, who shall be chosen from the electrical experts in the employ of the insurance interests. The officers are also ex-officio members of the Electrical Committee. All meetings of the association must be held at the national board rooms, in New York City. The officers and Electrical Committee, which have remained unchanged since the organization of the association, are as follows: President, C. E. Bliven, of Chicago; Vice-President, W. A. Anderson, of New York; Secretary and Treasurer, C. M. Goddard, of Boston; Electrical Committee: F. E. Cabot, of Boston, Chairman; William McDevitt, of Philadelphia; George P. Low, of San Francisco; A. E. Van Geisen, of New York; E. A. Fitzgerald, of Syracuse; Edward Leloup, of New Orleans; W. H. Merrill, Jr., of Chicago; A. M. Schoen, of Atlanta; and E. A. Braddell, of Philadelphia. At this December meeting, the rules formulated at the August meeting were again carefully gone over and amended as seemed necessary, after which every person present agreed to recommend to their respective associations that they be adopted as the standard for the territory under their jurisdiction.

The next meeting of the Electrical Committee was held on August 17th, 1893, in Chicago, and an adjourned meeting was held on September 5th, in Boston. As the rules adopted at the meeting in 1892 had then been in use by most of the principal underwriters' associations for nearly a year, the committee had the advantage of suggestions and criticisms drawn from the actual application of these rules, and they were again carefully taken up, section by section, and such changes and additions as experience seemed to indicate to be desirable, were adopted. At this meeting, also, the word "approved," which was frequently used in the first edition of the rules to describe wires and devices, was defined, and these definitions were incorporated in the rules themselves. A list of wires which had been found to comply with the requirements of the rules was also published, and a resolution was adopted calling attention to the liability of the destruction of metallic substances, especially water and gas mains, buried in the ground, by electrolysis due to the ground return of single trolley street railway systems. This resolution was sent to the various boards of underwriters to call their attention to a matter which was of practically very recent development, and correspondence was invited on the subject.

The work of Mr. Merrill, in Chicago, in connection with the Electrical Committee, is worthy of special notice. Starting first with the idea of collecting and distributing as full information as possible in regard to fires due to electricity, he has gradually established a department which is of great assistance, not only to the electrical inspectors of the country, but also to the insurance companies and their various field representatives. His fire reports, on behalf of the committee, have become well known, and have no doubt had the tendency to lessen the number of electrical fires by calling attention to the various inspectors to the probable causes which may develop an electrical hazard, as shown not simply in the experience of one man, or in one particular section, but in the experience of many inspectors, covering nearly the whole territory of the United States.

Further than this, he has established a testing bureau and a system of distributing reports of the results of the tests there made, so that every inspector has the advantage of the experience and knowledge developed by a fully equipped and well-managed testing labaratory. These reports have been of inestimable value in ridding the market of cheap and poorly constructed material and devices. The reputable manufacturers, being glad to remedy any defects shown in these reports, have improved their devices, and the goods of other less reputable parties have been, to some extent, driven from the market. It is the duty of every insurance inspector, and it is hoped that it will be the pleasure of all connected with electrical interests, to furnish Mr. Merrill with as full data as possible relating to electrical fires, and devices and materials, which may come to their attention.

The next meeting of the Electrical Committee was held in New York, on December 19, 1894. The changes in the rules made at this meeting were very few, but quite a large number of general subjects were taken up and considered and referred to special sub-committees.

The most important action taken at this meeting, however, was the adoption, with the sanction of the Committee on Lighting of the National Board, of a resolution that the members present at the meeting would urge upon their respective associations an agreement to adopt and use the rules for safe wiring, as adopted by the National Board of Fire Underwriters, on the recommendation of the Electrical Committee, and that these rules should be printed only by the National Board, and that no changes or additions should be made except as promulgated through the National Board. The adoption of this resolution, and the acceptance of the plan proposed by practically all of the underwriters' associations of the United States, at last brought about the result which was chiefly in the mind of the Secretary of the New England Insurance Exchange when the first meeting was called, that is, an absolutely uniform set of rules for electric light and power wiring throughout the United States. That this result has been accomplished, is shown by the fact that forty underwriters' associations have ordered copies of these rules printed from the same type.

The Electrical Committee, feeling that the adoption of of the rules, recommended by them, by the National Board and nearly all the underwriters' organizations, and their incorporation in the ordinances of some twelve or fifteen cities, had established the fact that their work had proved itself, so far as these rules are concerned, to be practical and satisfactory as a whole, considered that they were now in a position to invite general criticism from all those engaged in the electrical business. (The rules had previously been submitted to and approved by representatives of the most prominent electrical manufacturers and central station men.)

Early in October, 1895, the committee sent out a circular letter with blanks, practically broadcast, inviting such suggestions for changes or additions in the present rules as could be made and supported by what to the person making them seemed to be good and logical arguments for their adoption, with a statement that these suggestions would receive careful consideration at the meeting in December of that year. A very large number of suggestions were received, and this brings us to the meeting of the Electrical Committee, which has just closed its sessions this past week.

At this meeting the discussions and votes were not confined to the members of the Electrical Committee, but the full privilege of both discussion and voting were extended to all present.

Chairman Cabot opened the meeting with a short address, the recommendations in which were referred to a special committee, and on their recommendation the following resolutions were adopted :

Resolved, That any increase of voltage on interior incandescent lighting circuits would result in a corresponding increase of danger to life and property, and that, owing to the tendency toward the introduction of high voltages, it be urged that extreme care be taken by inspectors and others in charge of such installations, without which we believe serious hazards may be incurred;

Resolved, That the members of this Committee, and other Electrical Inspectors here present, pledge ourselves to exert our influence to further the enforcement of the rules and requirements of the National Board of Fire Underwriters, and to co-operate with the Electrical Bureau of said Board in furnishing that Bureau with facts that come under our observation regarding devices and materials which may not be constructed in accordance with these rules and the introduction of which would create a hazard to property.

Resolved, That we further agree that all bureau reports received setting forth such facts shall receive careful consideration, and the findings of the report be followed out as far as possible in our respective territories, to the end that co operative work along these lines may be established and uniformity of action in all essential matters secured.

Resolved, That the introduction of trolley wires in municipal districts is inimical to the safety of the property of the inhabitants of such districts, and that because of this fact all possible precautions should be taken by the managers of trolley roads throughout the country to insure cutting the current off the wires in case of fire in abutting property; also, that trolley wires should be effectually protected against the possibility of contact between them and other conductors; also, that trolley systems should be so arranged that practically no difference of potential, due to the effects of trolley roads, should exist between subterranean pipes.

A committee consisting of Messrs. French, Goddard and Sweetland was appointed to consider and report on the question of how best to guard against the hazard due to the possibility of the breaking down of the insulation between the primary and secondary transformer coils, this subject being considered of importance, especially in view of the tendency toward extremely high voltages in long-distance transmission.

The matter of preparing rules to govern marine wiring was referred to Mr. Sweetland for a report.

The subject of protectors which should obviate the hazard due to the liability of wires, such as telegraph, telephone and similar signal wires, becoming crossed with electric light or power wires, was referred to a committee consisting of Messrs. Cabot, French and Merrill.

The above committee will report at a later date.

The Secretary was instructed to submit his proof of the revised rules, as taken from the minutes of the different members of the committee, before sending to the printer. He was also instructed, in accordance with suggestions made by several parties, that in compiling the rules the definitions be incorporated with the rules themselves instead of printed as an appendix.

It was voted that the Secretary advise all persons who sent in suggestions which were not adopted, of the reasons given by the members of the committee for their rejection.

The changes made in the rules, while they were considerable in number, were very few of them radical, and the general class of work which now receives the approval of the underwriters under the present rules will not be greatly affected. It seemed to be the general opinion of those present that the rules were working satisfactorily, both to the insurance and electrical interests, and that only such changes should be made as were necessary on account of the progress of the electrical industry itself, or where experience had shown that additions to the present rules were required.

The following are some of the more important changes made, and are given in the order of the sections amended in the present rules :

The grounding of the frames of generators may be allowed, when necessary, by written permission, this change being made on account of the introduction of direct connected and extremely large and heavy machines.

Switches for motors must hereafter plainly indicate whether the current is " on " or " off."

Rules were adopted requiring wires to be protected from mechanical injury in buildings when nesessary; high potential wires by substantial boxing, giving a reasonable air space, and low tension wires either by boxing or by an approved iron armored conduit tubing.

It was ruled that the mesh of wire netting for arc-light globes should not exceed $1\frac{1}{4}$ inches.

Switches on hanger-boards must cut out both poles of the lamp.

The use of wire smaller than No. 14, B. & S., will not hereafter be allowed, except for pendant and fixture work.

The rules as to the construction and painting or " filling " of moulding were made more explicit.

The rules for special wiring in breweries, etc., will require that joints and splices be avoided as far as possible, and that switches in damp places be mounted on porcelain knobs so as to give an air space behind them.

It will hereafter be allowable to draw strings into conduits for the purpose of pulling in the conductors, which should not be placed in the conduit until the mechanical work on the building has been completed as far as possible.

Hereafter cut-outs will not be allowed in the canopies or shells of fixtures.

Hereafter circuits must be arranged so that no group of lamps, whether on the same fixture or not, requiring a current of more than six amperes, will be allowed to be ultimately dependent upon one cut out, except that special permission may be given in writing for departure from this rule in cases of large chandeliers.

Steps were taken which will tend to improve the character of the double conductor, and hereafter, except for pendants and fixture work, a solid rubber insulation, protected by durable braid, will be required for flexible conductors.

Supports for motor ceiling fans must have an insulator interposed between them and the motor.

The electrical requirements of the standard for car barns and repair shops, as contained in the schedule now used by a number of rating organizations, are now to be incorporated in the rules.

Service switches must disconnect all of the wires entering the building — that is, on the three-wire system, all three wires must be opened by the operating switch.

The use of brass sheathed interior conduit and vulca tubing will not hereafter be approved for bushings.

The use of incandescent lamps in series circuits for decorative purposes will be allowed by special written permission when installed in a proper manner.

Rules for electric heating apparatus were adopted which will require, in addition to the general wiring being done in accordance with rules, that the switches shall plainly indicate whether the current is on or off; that the attachment of the feed wires be in plain sight; that stationary heaters be treated as stoves, and that the flexible conductor necessary for use with flat-irons and other devices of a similar nature shall have an insulation that will not be injured by heat, such as asbestos, which insulation must be protected from mechanical injury by a substantial outer braiding.

The above constitute the principal changes in the rules.

The suggestion that the table of safe-carrying capacity for wires was too near the actual limit of safety was referred to the chairman of the committee, for tests, investigation and reports.

The matter of obtaining more effective and more efficiently-constructed devices for automatic safety cut-outs was referred to the committte on tests, with request that they obtain all the information possible in relation to the proper construction of fuse blocks, length of fuses and efficiency of fuse metal, in connection with currents of various quantity and potential.

The attention of the committee was called to the fact that it was claimed by storage battery experts that these batteries were extremely subject to damage by water in case of fire.

The committee on tests were requested to report a standard for iron or steel armored conduits which should meet the approval of the committee.

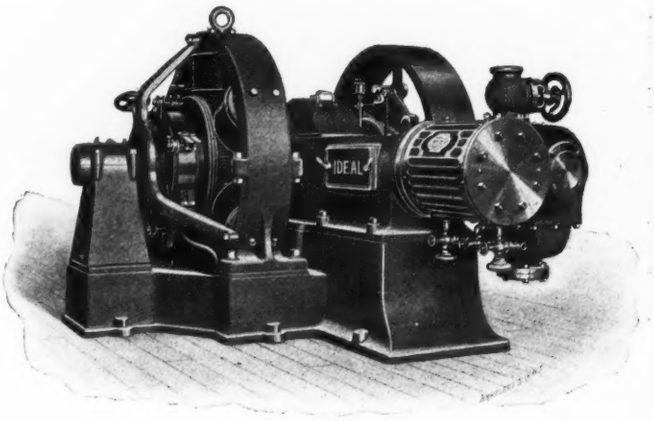
A communication from Mr. Edward H. Johnson, of the Interior Conduit and Insulation Company, setting forth the merits of that class of wiring, especially that of the iron-armored conduit, and suggesting that insurance companies should encourage this class of construction by a reduction in the premium on risks so wired, was read and placed on file.

The Trade.

In responding to advertisements in this publication, please mention "The Journal of Electricity."

THE ABNER DOBLE COMPANY.

Of late there has been a marked tendency among old and well-established mercantile houses on the Pacific Coast to enlarge their sphere by incorporating one or more branches of the electrical industry into their business, and particularly has this been the case in instances where electrical applications have formed almost indispensible links, or very important factors in their present industries. The Abner Doble Company of San Francisco is pre-eminently conspicuous among such houses. Its years of experience have placed its name among those of the most solid and best-known concerns on the coast, and it may be said that hardly a transaction occurs involving the placing of orders for iron and steel, or the erection of steam, hydraulic, pneumatic or mining equipments, without having connected with it, directly or indirectly, the name of the company referred to.

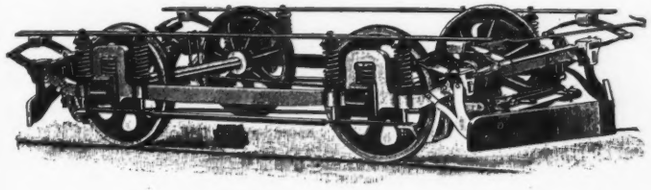


Abner Doble Co. Agents.

Abner Doble Co. Agents.

That its aims to keep abreast of the times are fully accomplished, is attested in the fact that this well-known concern has embarked in the electrical business to an extent as great, if not far greater, than has any other strictly non-electrical company. Foremost among the Eastern concerns which have entrusted the management of their Pacific Coast business to the Doble Company, is the Walker Manufacturing Company, of Cleveland, Ohio, whose high grade electric railway equipments and general electric lighting and power apparatus have at once taken rank with those of the great electrical manufacturing companies, because of general excellence in materials and workmanship. Though it has been in the electrical business but a comparatively short time, the Doble Company has succeeded in placing two large Walker railway generators in California, one of 400-KW.

in Oakland, and one of 800-KW. in Los Angeles, the latter forming the largest single generater west of the Rockies. In addition, numbers of street railway equipments, incorporating the novel and essential features of spring-mounted construction, have been sold, the most



Abner Doble Co. Agents

noteworthy order being that of the Sutro Railroad Company, of San Francisco.

Prominent among the other agencies held by the Abner Doble Company are those of the Crocker-Wheeler Electric Company, whose dynamos, motors and dynamotors are standard the world over; the General Incandescent Arc Lamp Company which, as the successor of the original Bergman Company, has improved the almost unequalled facilities it possesses for manufacturing strictly first-class arc lamps for all circuits; the Dorner & Dutton agency for car trucks and accessory railway appliances; and of Billings & Spencer, the well-known manufacturers of drop-forged commutator bars and overhead materials. Chief among the other allied interests represented by the Abner Doble Company, is that of A. L. Ide & Son, of Springfield, Illinois, manufacturers of the well-known "Ideal" high-speed engine, an application of which is shown in the accompanying illustration.

A San Francisco contemporary, the "Journal of Electricity," has in its October issue some most charming pictures illustrating an article upon "Night Photography by Electric Light." Some of the effects obtained are peculiarly beautiful, and if anything could tempt one to join the already overcrowded ranks of the amateur photographers, this article and its illustrations would do it.—"Electricity," London, Eng.

J. W. BROOKS & CO.

The subject of this article is a comparatively youug concern, which has within the limited period of a few brief months forged ahead to the foremost rank among the electrical supply houses of the Pacific Coast. It was established last summer by Mr. Brooks, in the belief that the Far West offered a choice field for the handling of selected agencies for electrical specialties, and originally made a specialty of street-railway materials of all descriptions, but owing to the repeated calls for other goods in varied lines, the house of J. W. Brooks & Co. has been extended from time to time, until its agency handles supplies of almost all descriptions pertaining to railway, lighting and power purposes. From the outset it has evidenced particular care in the selection of its agencies, in the promptness of shipment, in the protection of its credit, etc., until now its business has been built up so that its rating is very satisfactory.

To detail the specialties of the enterprise is obviously impossible, except in a general way, but by way of illustration may be mentioned that of the Card Electric Motor and Dynamo Company of Cincinnati, whose dynamo-electric equipments, including motors, generators and motor-generators for direct currents are made in all types and all sizes. These machines are of the highest efficiency, and no expense has been spared in either the material or labor. They have sight-fed oil glasses, self-oiling and self-aligning bearings, steel pole pieces, laminated armature, etc., etc. The prices given include insulating base, belt tighteners, pulley, rheostat, main switch and boxing, and all machines are guaranteed against any electrical or mechanical defect, for one year after date of sale.

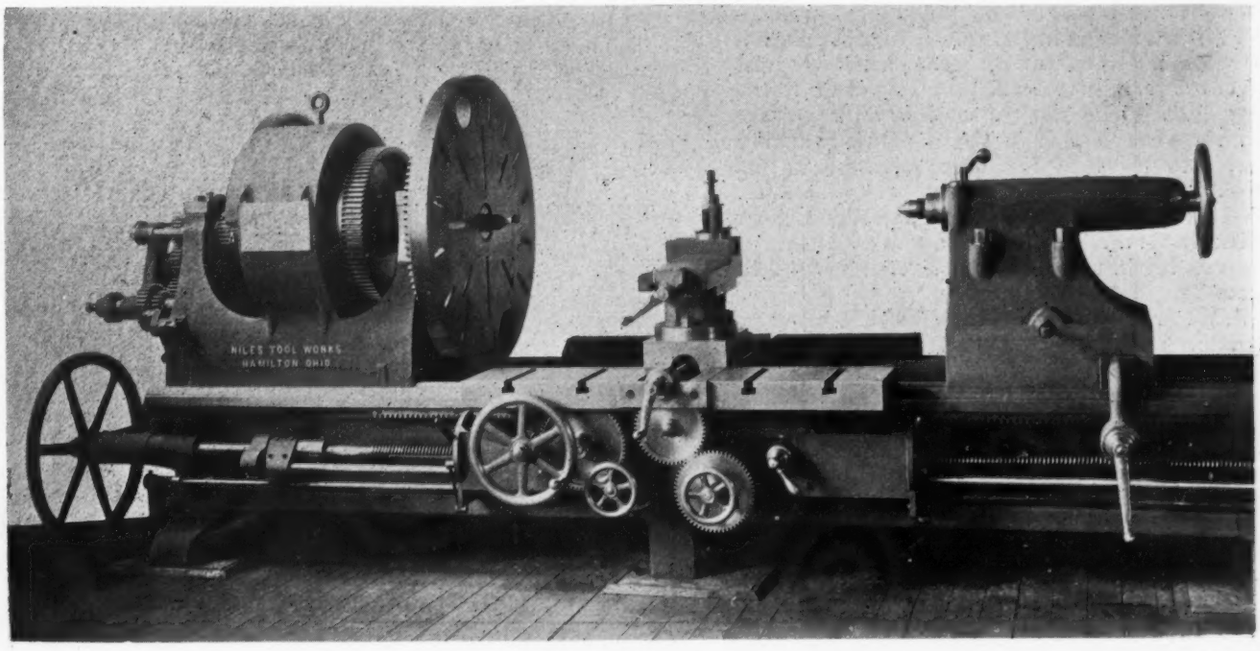


FIGURE 1—*A Card Motor, direct connected to a Niles forty-six-inch Lathe.*

A feature of electrical development that will commend itself to general machine-shop interests, and which has been made a specialty by the Card Company, is the direct application of electric motors to all kinds of power machinery, such as lathes, drills, planers and printing presses. One such application is illustrated herewith, showing a Card electric slow-speed motor mounted on and direct connected to a Niles forty-six-inch lathe. The advantages accruing from such con-

struction are manifold, as it eliminates the use of belting, loose pulleys, etc., and enablds a shop to be driven with less than fifty per cent. of power than would be necessary in the use of long lines of counter shafting with belts and speed-changing gear. Another application of Card apparatus that has received great attention is the manufacture of direct-connected dynamos, a small installation of which is shown in Figure 2.

Other noteworthy agencies are held by J. W. Brooks & Co., among which is that of the Mica Insulator Company of New York, manufacturers of the well-known "Micanite," so universally used in street railway and general electrical construction. A single reference will show the desirability of using micanite. A recent number of the London "Electrical Engineer," in describing the gigantic de Ferranti alternator recently erected in the Deptford station, thus alludes to the construction of its thirty-five-ton armature:

"The smaller end of it is solid brass, burnt on to the strips; and to this is connected the inner end of the bare copper conductor. The segment is then wound with the conductor, which has corrugation to prevent side displacement, and the adjacent turns are insulated. The insulation between the carrier and the coils is effected with micanite shields. The field coils on this de Ferranti alternator are constructed by winding bare copper strips on edge into a spiral, with insulation between adjacent turns. The carriers consist of two heavy brass castings clamped on to the segments. The danger of the high voltage from the bare copper of the armature sparking across to the field has been overcome, in this case, by placing micanite caps over the poles. These caps, which are about one-eighth inch thick, have all been tested up to 25,000 volts. Since being in use, no faults have developed in them."

J. W. Brooks & Co. also handle the Boudreaux dynamo brush west of the Rockies, the brush which, when once introduced to the station manager, is sure to find a good friend in him, for it requires no attention, running, as it does, without sparking, cutting or the necessity for lubrication. "Universal Lamps," too, have become extensively used on the Coast through the exertions of this enterprising firm; and in this connection it is interesting to note the sale of over 25,000 Universal lamps in Oregon and Washington, between November 15th and December 10th. The San Francisco Savings Union operates an isolated storage-battery plant in its building in San Francisco, and as in such installations the fluctuations in voltage are reduced to a minimum, the conditions are favorable to the use of the highest efficiency lamps attainable; accordingly Universal lamps, consuming but $2\frac{1}{2}$ watts per C P., are used on its 120-volt circuit, thus making the current consumption of the lamp to be but .35 of an ampere. A further innovation is that of the Universal decoration lamp, consisting of a porcelain base about six inches long, on the top of which is a small ground glass globe, containing the lamp itself, thus forming an accurate representation of a burning candle.

In brief, no further proof of the growing popularity and prosperity of the firm of J. W. Brooks & Co. could be offered than a statement of the fact its business has so increased during the past few months as to necessitate its removal from the present office, at 120 Sutter street, San Francisco, to 523 Mission street, where it has leased the ground floor and basement, and which will be occupied on and after January 1st, 1896.

The Lay Press.

POPULAR REFLECTIONS OF THE CONDITIONS AND PROSPECTS OF ELECTRICAL ENGINEERING ON THE PACIFIC COAST.

In 1886 there were seven horse railroad companies in Oakland, operating eight or ten lines. In that year the first cable road was built, superseding one of the horse-car roads. There was then no other change until about 1890, when another cable road was constructed, and also the first electric railroad. Monday night the last horse-car line was abandoned and the last horse-car turned into the stable to come out no more. The two cable roads are being turned into electric lines, and soon the cable cars will follow the horse cars into innocuous desuetude. The victory of electricity has been quick and complete.—Oakland (Cal.) Enquirer.

It is a doubtful proposition whether a canal company [in the endeavor to reserve exclusive privileges of developing electric light and power from the water power of its canal] can claim water that flows from the quartz mills. It is a still more dubious question, whether, even conceding its right to the water, it can exercise jurisdiction over it while passing over private lands, that will perpetuate its running to waste, under circumstances where it might, without any diminution of the supply, be made to serve a useful purpose. It is also a dubious point whether the canal company—a corporation formed for the express purpose of selling the use of the water to others—can make distinctions for or against individuals. It would seem reasonable that the company would be legally bound to sell to whoever is prepared to pay the price, so long as it has water to dispose of—that the canal company can no more refuse to sell than a railroad company or stage proprietor can refuse a passenger who applies for transportation.—Jackson (Cal.) Republican.

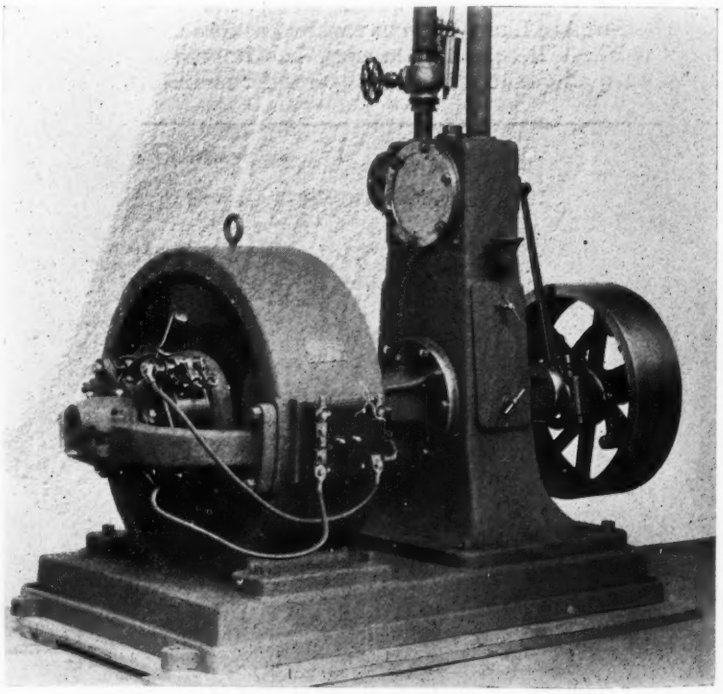


FIGURE 2—*A Direct-Connected Card Dynamo.*

Chas. B. Luck, of Dubuquee, Io., write: "Enclosed please find one dollar for subscription to 'The Journal of Electrity' for one year. I have received one number, and am very much pleased with it. It is newsy and not *too* theoretical, as so many of our Eastern papers are inclined to be."

A trolley wire hanging down
Essayed to paralyze the town.
Through it a fiery current ran
That ever hummed: "I want a man.
I want a man to sizzle hot,
To fry into a greasy spot—
To toast, to roast, to broil, to bake,
To singe a man I fairly ache."
Just then arrived a dairy team:
"Now here's a chance; well, I should scream!"
Thus loud the merry wire sang
And struck the nigh horse with a bang.

Down dead he fell, his mane a-scorch.
His tail ablazing like a torch;
His legs were doubled at the knees,
His smoking hoofs perfumed the breeze.
The wire hanging close the earth
Was seen to shake with inward mirth.
"I wished," it hummed, "for higher game—
Thanks for the practice just the same."

Repairers made the wire taut
And it behaved as wires ought—
Propelling cars at reckless rate,
The human race to decimate.
"Well," mused the wire, "this is fine;
Why should I murmur or repine?
Than not to kill 'tis better far
To boost along the fatal car."
Thereafter when a man was slain
The wire sang with glad refrain:
"The car is not alone," it said,
"A trolley wire's overhead;
Good people all look up and see
Grim Death's in partnership with me."
—San Francisco Examiner.

A company has been organized, with $500,000 capital, to install an electric plant at Horseshoe Bend, on the Merced river, and furnish power to the Coulterville mines, incidentally lighting Coulterville. The rich Utica company is to put in a plant at their great mine at Angels' Camp, the mines about Sonora are to be operated by means of this unseen power, and from all parts of the State come reports of like nature. The electrical age is upon us.—Modesto (Cal.) Herald.

It is a surprise to us that something is not done by the Southern Pacific Company towards substituting electricity for steam on the local lines. It would be much nicer, safer, cleaner, and in every way more appropriate. Above all, we have no doubt it would be cheaper. They have large electrical locomotives successfully running in the East, and they would be especially adapted for this work. Alameda is becoming so thickly settled that the big locomotive engines, belching smoke and cinders and making terrible noises with bell and escape of steam are getting out of date.—Alameda (Cal.) Argus.

The lateness of the rains this year, even in the mountain districts, has caused a scarcity of water, and as much of the power which is used in the mines to operate machinery is water power, they have felt the scarcity of it. The water which could be brought to the mines having run out, some of them shut down or have been working only a portion of the force. There is much water power in the mountains, which is so located that it cannot be delivered where it can be used without great cost. The miners have therefore conceived the idea that where the water cannot be flumed and ditched to them they will go where the power is, and by converting it into electric force they can convey it where water cannot be taken.—Stockton (Cal.) Independent.

The purpose [of an electric transmission company soon to be incorporated to construct a plant on the Merced River, near Horseshoe Bend] is to furnish the power required for all the mines in the district, and as there is no power available for that locality except at this point on the river, its importance as a factor of prosperity is self-evident. It is further emphasized by the recent action of the United States Government agents, who have stopped the cutting of wood on the public domain, and threatened wholesale and indiscriminate arrest of trespassers. It may be mentioned in this connection that, as a matter of fact, there is no appreciable amount of wood or timber convenient to this section of country outside of Government land, and if parks and reservations increase in number and area, it will not be many years before there will be a scarcity of fuel for domestic use.—San Francisco Call.

When the city electrician or anybody else makes a showing of figures to the effect that the "actual" cost of Alameda's light for the month of September was no more than $594.84, he is assuming that the tax-payers of this city are fools, and ignoring the fact that they have had nine years' experience with this big, white elephant. Every previous electrician has been a great hand at figures, just like the incumbent. But in the end the tax-payers have always had a fine large expense to meet. There is no use of arguing against electricians' methods of casting up accounts, especially as long as those methods find favor in official quarters; but at the end of the fiscal year we shall publish from the City Treasurer's books figures showing the amount of money that the city has paid on account of its electric light plant, and whatever it is, that will be the only reliable record. We have no hope whatever that it will be less than it has been in the past, and, we believe, from signs that have hung out, that it will be more.—Alameda (Cal.) Argus.

Except in two or three instances, there has been but little difficulty in securing rights of way [for the pole line of the San Joaquin Electric Company]. But now and then there has occurred what the officers of the company are pleased to designate as a "genuine hold-up." They cite the case of a large farmer who asks at the rate of $1000 an acre for the right of way to set poles across his wheat field. But this is child's play in comparison with what a wealthy lady asks for the right of way to set poles for a mile and a half across a rugged mountain where the only use the land can be put to is range for sheep. She asks that, in consideration for the right of way over this mountain, the company cut the wood off the land near the line, and deliver it to her free; put in a telephone in her house and connect it with the city and keep it in repair free; to pay her $100 cash; to pay her attorney whatever he may charge for drawing up the papers and attending to the business; and, in addition, to furnish certain incandescent lights, about eighty in number, free of cost for fifty years. The cash value of what this wealthy lady asks for the right of way across the sheep pasture is more than $50,000. It is perhaps superfluous to say that the electric company will bring suits to condemn the rights of way in the cases mentioned. —Fresno (Cal.) Republican.

In view of the awakened interest on the part of our citizens in the San Jose and Saratoga electric railway, the Mercury has been at some pains to glean some facts that will be of advantage to property owners and business men of San Jose. For this purpose a representative of the Mercury made a tour of investigation at Oakland and points between that city and Haywards, obtaining facts from merchants and other reliable sources as to the effect upon business in those places since the completion of the Oakland and Haywards electric road. This road is but a couple of miles longer than the proposed Saratoga road, and for that and other reasons has many features in common with the enterprise under way in this city and county. The Haywards road, while excellently built and equipped, does not come up to the standard of the road proposed to be built by L. M. Hale, as the rails of the former are but forty pounds to the yard, while those of the latter will be sixty pounds. This difference materially and favorably affects the comfort of travelers, and is an important consideration to those using the road from day to day. Another fact should be borne in mind, and that is that while but $50,000 is asked as a bonus for the Saratoga road, $115,000 was subscribed for the Haywards road. If any business man in San Jose has a single doubt as to the pecuniary benefit of an electric road to this city from Saratoga, we would recommend the attention of such a one to the opinions of the business men in general in Oakland. The increase in population, too, has been remarkable, ranging from 30 per cent. to 400 per cent. along the line.—San Jose (Cal.) Mercury.

Reports of the Month.

COMMUNICATION.

KAMLOOPS, B. C.—Satisfactory progress is being made in the installation of the new telephone and fire alarm systems.

NEVADA CITY, CAL.—The Nevada County Electric Power Company has completed a private telephone line from its power house to Nevada City, and will probably continue the circulation to Grass Valley. The telephone circuit is run over the pole line carrying the 5000-volt two-phase power transmission circuits.

SAN FRANCISCO, CAL.—The Pacific Telephone and Telegraph Company is installing a kitchen telephone service for private residences, which includes the unlimited use of a metallic circuit equipped with the Blake transmitter and express service for $1.75 per month. These kitchen telephones are for outward service only, hence contain no magneto or other calling device.

MISCELLANEOUS.

SACRAMENTO, CAL.—A 20-horse-power multipolar 500 volt Westinghouse motor is being installed by the Southern Pacific Company for operating a drawbridge across the Sacramento river.

GREEN RIVER, UTAH.—Since Nov. 15th twelve car-loads of electrical machinery, costing $75,000, has been received by the South Park Mining Company from the East, and has been shipped to the Placer sand-bar of the Green River, seven miles distant, where it is being set up for the purpose of saving the fine gold that abounds in the sand-bars. Thirty men have been engaged to operate the plant, which will have a capacity of handling 4000 cubic yards of sand per day. Great secrecy is being maintained regarding the process used.

SAN FRANCISCO.—Direct connected Cahill-Hall electric elevators are being installed in the new N. S. G. W. Buiding and the Wilson Block.——Dr. Close, of the Torpedo service, has ordered five miles of six-conductor torpedo cable from the Roebling Company. This cable has an outside diameter of .26 inches, weighs 25 pounds per mile and each conductor consists of seven strands of No. 25 wire.——The Paul Boynton Chute Company has enlarged its electrical equipment by the addition of a 7½-horse-power Westinghouse motor for running a merry-go-round.

INCORPORATION.

EVERETT, WASH.—Copper Queen Mining & Improvement Company. Capital stock, $150,000. Incorporators, W. R. Stockbridge, C. W. Miller, C. H. Boynton, J. E. McManus.

SALIDA, COL.—The Salida Electric Company, to furnish electric light and power. Capital stock, $50,000. Promoters, Geo. A. Goddard, James E. Johnson and Geo. Brennan of Denver.

KALAMA, WASH.—The Orchard Water Company, to maintain and operate water and electric light works in any town in Washington. Capital, $7,000. Promoters, H. Orchard, J. P. Atkin and A. H. Innis.

LOS ANGELES, CAL.—The Pacific Coast Telephone and Electric Motor Company to manufacture telephones, motors, etc., and to construct and dispose of telephone and telegraph lines. Capital stock, $100,000. Promoters, L. M. Gibson, W. C. Harrison, Jno. MacCabe and S. Weathercott.

SAN DIEGO, CAL.—The San Diego and Back Country Telephone Company. Capital, $2500. Directors, Waldo S. Waterman of San Diego; J. E. Godvey of Mesa Grande; J. A. Verlagne and Geo. A. Telford of Ramona; S. Rotanzi of Santa Ysabel; W. J. McBean of Julien, and T. Stevens of Witch Creek.

TACOMA, WASH.—The Tacoma Auxiliary Fire Alarm Company, to install electric auxiliary fire alarm systems in Pierce County, Washington. Capital stock, $30,000. Promoters, J. M. Bell, B. K. Worley, D. B. Worley and W. A. Theodore.——Oregon Mining and Water Supply Company. Capital, $20,000. Incorporators, Wallace H. Jennings, J. T. Redmond, G. F. Shaw.

TRANSPORTATION.

MOKELUMNE HILL, CAL.—An electric tramway is to be built to carry ore between the Lamphear works and the Moser mine.

STOCKTON, CAL.—A belt line electric railroad of standard gauge and seven miles in length is to be built along the city outskirts.

SAN BERNARDINO, CAL.—The changing of the E-street road into an electric line and its operation by the Santa Fe system is rumored.

SEATTLE, WASH.—The promoter of the Seattle, Tacoma and Portland Electric Railway Company is H. L. Thomas, who is said to have Eastern backing, and who has a franchise now before the City Council of Seattle.

VANCOUVER, B. C.—The Black Diamond Mine will resume operations in January, soon after which it will install a tramway to the lake shore, to convey ore from the Black Diamond, Little Phil and Little Donald mining properties.

CHICO, CAL.—The project of building an electric railway from Biggs to Palermo and Honcut, crossing the Feather River near the Alexander & Hamman and W. Treat & Son division line, is probable. The same line extending from Biggs to Gridley and from Palermo to Oroville, then to Chico, would make a complete connection of all the principal towns in the county.

BERKELEY, CAL.—Newspapers report that a well-known engineer has been at work for some time drawing plans for the grid-ironing of Berkeley with electric railroads. It is also the intention of the company for which this engineer is at work to build two large ferry steamers like the San Rafael. The cost of the road, and steamers, wharf, etc., is estimated at $900,000.

PORTLAND, OR.—The Portland Traction Company has applied for permission to change the motive power of its street railway system from cable to electricity. The cable system is to be abolished entirely except on the big hill—Portland Heights. The cable will be run on the hill by electricity. The cars will be balanced on an endless cable, and the power of one going down will compensate for the power expended in sending one up, as is done on the 25 per cent. grade on the Fillmore-street line in San Francisco.

SACRAMENTO CAL.—The rights of way for the Sacramento, Fair Oaks and Orangeville Railroad have been practically secured. ——The Board of Supervisors has published a notice of sale, on January 6th, of an electric railway franchise, to run from Twenty-first and Y streets, this city, by various streets, out the extension of V street and on the upper Stockton road to the Capitol school-house.——The Board of City Trustees also offers for sale, on January 6th, an electric railway franchise for a line on Twentieth street, from V to Y street.

OAKLAND CAL.—The City Attorney has been instructed by the Council to prepare an ordinance forfeiting the Whitmore street railroad franchise along Franklin street.——The electrical equipment of the Hills division of the Piedmont Consolidated Cable Railway Company has been completed and cars have been run over the same, although regular operation by electricity will not begin before New Year. This completes the displacement of the cable system for regular operation on week days, although the cable will be run in addition on Sundays to meet the heavy traffic that then occurs.——E. B. Vandercook, projector of tne electric railroad from Oakland to Livermore and the Corral Hollow, has returned from the East, having received substantial encouragement in the way of securing capital for the proposed road.

MAYFIELD, CAL.—At a meeting held at Saratoga on December 2d, the sum of $45,000 was subscribed towards the building of an electric road from Saratoga to Mayfield. Prominent among those present were F. M. Farwell and H. W. Postlethwaite, but it is believed that the meeting was held in the interest of the Saratoga syndicate, whose large land holdings in the vicinity of Mayfield and through West Side, Saratoga and Los Gatos make it important that rail connection with the Southern Pacific be provided. Some of the capitalists who were represented are also interested in the reorganization of the San Francisco and San Mateo Elec-

tric Railway, the present terminal of which is at Baden, but which will soon be extended to Palo Alto and thence to Mayfield. The line will be continued through to Los Gatos.

San Jose, Cal.—L. M. Hale has withdrawn his proposition to construct an electric railway from this city to Saratoga, because of the failure of the citizens of San Jose to subscribe the $50,000 required. The action of Mr. Hale has aroused the public, and the press is now endeavoring to induce him to reopen his proposition.——W. T. Weber of Burlington, Iowa, proposes to build, equip and operate an electric road to Saratoga, provided the public will subscribe $60,000 to the road on the following terms: This sum of $60,000 shall be payable in two payments; one half shall be deposited in the Garden City Bank subject to his order within thirty days after the construction of the road commences and the iron rails for the road have arrived in San Francisco. The other half of the sum designated shall be secured by first-class notes payable on January 1, 1897, in San Jose, and deposited in the above named bank. Mr. Weber guarantees to commence work within 30 days after the cash deposit of 50 per cent. has been placed in the bank. All this sum must be in the bank by May 1, 1896. In return for such subscription Mr. Weber proposes to issue to each subscriber a certificate to the full amount of his subscription, which will be good for its face value in payment of freight or passenger charges over the road. No one subscriber, however, will be allowed to collect more than 25 per cent. of his subscription in one year, but he may collect 25 per cent. yearly for four years, thus getting the entire subscription back in four years time. No one will be forced to collect the amount in this time, as the certificates are good until used. Mr. Weber says he has constructed sixty miles of road in Oregon on this plan, and it has worked with wonderful success for the public. He has a fine road in the suburbs of Portland, a system at Dayton and another at Dallas. He says he has constructed many miles of road in the East, and with success in every instance.——The Board of Supervisors invite bids for the sale of an electric railway franchise on January 8th, from a point beginning at the southern terminus of the First-street railroad on the Monterey road, southerly along said road for a distance of 1900 feet.

San Francisco.—The Sutter Street Railway Company has just placed 19,000 feet of 1¼-inch rope in its Pacific Avenue and 12,000 feet of 1⅛-inch rope for lower Sutter street, all being of Roebling manufacture.——Four double 25-horse-power Westinghouse equipments have been sold to the Market-Street Railway Company.——The Market-Street Railway Company has concluded to resume the payment of quarterly dividends on and after Jannary 1st, and it is thought that the payment will be at the rate of 20 cents per share per month during 1896. It is reported that the company now has on hand in its surplus fund $563,000 for dividends for paying purposes. Until the recent decision of the State Supreme Court, declaring the $17,500,000 bond issue of the company legal, it was necessary to draw on the surplus in addition to borrowing a great deal of money for the electric road extensions. The Hellman syndicate had agreed to take the first $2,000,000 of the bonds, but declined to pay over the money until their validity was established. The syndicate, however, advanced $1,000,000 in cash to the company on personal notes, with collateral security. This money, with the company's surplus and loans from the Pacific Improvement Company, were the financial resources of the combine for carrying on its improvements, pending a court decision on its bonds.—— The construction department of the Market-Street Company has commenced changing the Tenth-street horse-car roadbed into an electric line, and has about finished the Bryant-street system, which will be turned over for regular operation shortly after New Year. The new line will run from Second and Market streets via Bryant to Twenty-sixth and Mission streets, with a branch line on Folsom street running from Second street to the ferries, transfers being exchanged at Second and Folsom streets.——The intention of the Market-Street Railway Company to center an extensive street car system at the Southern Pacific Depot at Third and Townsend streets is announced, in anticipation of the completion of the coast line of the Southern Pacific Company, over which through trains will be run between this city and New Orleans direct without crossing the bay. The Kearny-street electric line at present runs from North Beach to the Southern Pacific depot, continuing on to the Potrero, while it is believed that the recently completed electric lines on Ellis and Turk streets will be continued across Market street, thence down Fourth ond Fifth streets respectively, terminating at Third and Townsend streets. It is not probable that the cable will be displaced on Market street until the electric underground conduit system has been pronounced an undoubted success.——The Tamalpais Land and Water Company has guaranteed an order for 650 long tons of 56-pound steel rails to be used in the construction of an electric road from Mill Valley to the top of Mount Tamalpais, a distance of seven and a half miles. The eventual extension of the road to Bolinas is probable. The maximum grade will be 7½ per cent., and its summit will be at an elevation of 2500 feet. S. B. Cushing, of San Rafael, is the promoter.——The Pressley single track system is undergoing test at the Pacific Rolling Mills, where 400 feet of track has been laid, upon which is run a 32-foot car of the single rail type, which is kept poised by the fact that the weight upon the wheels is considerably below the center of gravity.

TRANSMISSION.

Philipsburg, Mont.—It is said that F. E. Grimes will soon erect a steam hoist on the Trout mine.

Ogilvie, Cal.—The Golden Cross Mining and Distilling Company is installing a 5-horse-power Westinghouse motor.

Merced Falls, Cal.—The Merced Falls Electric Power and Manufacturing Company is clearing ground for the transmission station it expects to erect.

Angels, Cal.—The Utica Mine is about to install a 2000-horse-power transmission plant, which will be the largest installation operated at any mine in California. In all probability Westinghouse apparatus will be used exclusively.

Bakersfield, Cal.—The Kern River and Los Angeles Electric Power Company, through Gen. Chas. Foreman, President, has applied to the Board of Supervisors of Kern county for the rights of way for transmission lines through that county.

Sacramento, Cal.—The material for construction of the independent power circuits is expected from the East in a few days, and soon after the Sacramento Electric Light and Power Company will be prepared to fulfill more of its power contracts.

Provo, Utah.—Manager T. A. Davis, of the Hercules Power Company, is authority for the statement that the surveys for the proposed transmission of the Provo Power Company are now being completed, and that the contract for its erection will be awarded shortly.

Jamestown, Cal.—The App Mine is arranging for the installation of a power transmission plant because of the shut-downs which are necessary before the winter rains set in because of scarcity of water for power purposes at the mine, abundant water power being available unfailingly a few miles distant.

Logan, Utah.—The Hercules Power Company hopes to have its transmission circuits in operation by New Year, and, in addition to furnishing light, the company expects to provide power for the operation of an electric railway system which it is designed shall connect the several towns in this locality.

Sonora, Cal.—Three electric hoists have just been installed by the Westinghouse Company in the Miller & Holmes mine.——Iron pipe in 8, 12 and 14-inch sizes is being delivered for the new pipe line of the Sonora Electric Light and Power Company at the Marble Works, near Columbia, and the new dynamos were contracted for delivery about Christmas.

Livingston, Mont.—The Park View Mining Company, at Crevasse, are arranging to make extensive improvements on their property early in the spring. Development work will be pushed during the winter, and early next season a five-mile flume and a 100-stamp mill, with a complete electric plant, will be placed in operation. J. W. Hulse is the company's superintendent.

SEATTLE, WASH.—The proposition to issue $1,250,000 in warrants for the construction of the proposed Cedar River water system was carried, on December 11th, by a large majority. The scheme contemplates carrying water at high head into this city, where it will be used for running an electric power plant before being run into the city mains. F. H. Osgood is the promoter.

LOS ANGELES, CAL.—Bids will be received by the Supervisors up to 2 P. M. January 22d for a franchise to erect, maintain and operate a line for the electrical transmission of energy for a period of fifty years, commencing at a point on the boundary line between Los Angeles County and Kern County, where the transmission lines of the Kern River and Los Angeles Electric Power Company cross said line, thence in a sontherly direction by the most direct and practicable route to the city limits of this city.

PORTERVILLE, CAL.—The Kaweah Irrigation and Power Company is constructing the canal which will supply water for the operation of the proposed plant to be located at Lime Kiln. A mile of the most difficult portion of the canal, which will be about five miles long, is finished. The canal is twenty feet wide at the head-gate; the bottom eleven feet wide, the top thirty feet and the depth six feet. Some of the cuts are 14 to 15 feet deep, and one tunnel is 400 feet long. The canal will carry 200 cubic feet per second, and sixty men and 100 head of animals are now being employed.

SANTA CRUZ, CAL.— Final surveys of the water power of Big Creek have been rendered Fred W. Swanton, of the Santa Cruz Water and Power Company, which contemplates furnishing power for the operation of all the electric industries in this city. A flume 10,800 feet long must be constructed, which will give an effective head of 919 feet, from which the delivery of 585 horsepower in this city is proposed. The generating station will probably consist of two 300-horse-power Pelton water-wheels to operate one 225-kilowatt A. C. dynamo for incandescent lighting purposes, and a 150-kilowatt polyphase dynamo for power purposes.

NEVADA CITY, CAL.—John Martin, contractor for the pipe line, pole line and electrical equipment of the Nevada County Electric Power Company, has completed the construction of the pipe line from the flume to the power house, and it is expected that the plant will be in operation shortly after Christmas.——The contract for erecting the Nevada City pole lines of the Nevada County Electric Power Company has been awarded to the Electrical Construction and Repair Company of San Francisco, which also erected the entire transmission circuits of the company. Fifty-foot yellow pine poles, averaging sixteen inches in diameter at the butt by about nine inches at the top, are being used for all city circuits.

SAN FRANCISCO.—H. H. Clark, of Coulterville, Cal., who is now in this city, states that a new company, to be known as the Bend Power Company, is soon to be incorporated, with a capital stock of $500,000, for the purpose of constructing an electric transmission plant on the Merced river, one mile above Horseshoe Bend, where a 35-foot dam will be built, from which water will be conveyed by a flume one and one-half miles long, giving 93 feet fall. This will develop a minimum of 1800-horse-power during the low stage of the river, which continues from twenty to thirty-five days, while 4000 horse power can be developed for eight months of the year. Over 100 mines are within the district accessible by this power, the estimated cost of which is $150,000. Dr. F. M. Hopkins is the San Francisco representative of the proposed company.

STOCKTON, CAL.—President Doble, of Blue Lake Water Company, recently stated in an interview in this city that his company has "about concluded to erect a power plant at a point on the Mokelumne river, thirty-nine miles from this city. We have an abundant supply of water at that point, brought from about sixty miles from this city. The idea is to use the water first in the creation of electrical power for transmission to Stockton, and after the water becomes what is known as 'waste' to turn it off in a large ditch, and thus irrigate the orchard country around the Langford Colony. The object of a trip I expect soon to make is to meet with the property owners of that section and see if they are willing to assist us in the enterprise to the extent of contracting for water from the proposed canal. The scheme also involves the extension from Lodi of a substantial electric railroad operated by our electric power, back into Amador county, and possibly Alpine county also."

FRESNO, CAL.—The San Joaquin Electric Company is pushing the work of construction along the whole line of works, and is fast closing up the gaps, and expects to have everything in shape by January 15th for the machinery which will arrive about that time. The bridge across the San Joaquin River, one-half mile above the power-house, is completed, and is ready for the teams which will haul the heavy machinery and the supplies. The bridge is of the truss pattern, and is 100 feet single span across the channel of the river, while the approaches are 350 feet long. Six heavy wire cables, which were stretched across the stream and cleated to the rocks on both sides, furnished support for the timbers of the bridge during the work of construction, and when the truss was completed and the structure self-sustaining, the cables were taken out. One hundred and thirty tons of pipe for the line down the mouniain is on the ground, and the work of laying it will begin at once. The place for the pipe, from the reservoir to the foot of the mountain, has been cleared of brush and rocks, and the soil has been cleaned away to the solid granite. The pipes will be chained down every few feet to this granite bedrock. The reservoir is almost finished. and a few days more will see the last scraperful of soil dragged into place on the embankments. The water will then be turned in. The canal is done, and water has been flowing in its entire length for some time. Satisfactory progress is being made with the pole line, and 800 of the 2000 poles to be used have been distributed along the line, and the porcelain insulators have arrived, the shipment weighing 60,000 pounds.

ILLUMINATION.

CONCORD, CAL.—An electric light plant is talked of.

GENESSEE, IDAHO.—The electric light question is being revived.

SAN MATEO, CAL.—The new electric light plant is now in regular operation.

REDONDO, CAL.—The lighting of streets by electricity is being generally favored.

FLAGSTAFF, ARIZ.—Davis & Phelan have been granted an electric light franchise.

FORT BRAGG, CAL.—C. H. Wilson contemplates erecting an electric light plant.

ELKO, NEV.—W. T. Smith is to install a direct current central station in this place.

BENICIA, CAL.—A 125-horse-power engine has been placed in the electric light works.

WILLIAMS, ARIZ.—C. S. Wyncoop will be manager of the new Electric Light Company.

SAN PEDRO, CAL.—Ivan E. Tutt has been granted a 25-year electric lighting franchise.

USAL, CAL.—The Usal Lumber Company has installed a 30-light arc dynamo and plant.

FAIRHAVEN, WASH.—The steamer Lydia Thompson is to have incandescent electric lights.

DAVISTON, SAN DIEGO CO., CAL.—Plans for an electric light system are under consideration.

FORT BRAGG, CAL.—C. H. Wilson has been awarded a franchise for an electric lighting plant.

MURPHYS, CAL.—The electric light plant was started up by F. A. Mitchler on November 16th.

FORT BRAGG, CAL.—Chas. H. Wilson has been awarded a franchise for an electric light plant.

WILLIAMS, ARIZ.—Electric lights are talked of, and a franchise for same has been granted.

FERNDALE, CAL.—Wm. Kerri and Frank Nelson have applied for an electric lighting franchise.

RED BLUFF, CAL.—The Sierra Lumber Company has installed a 300-light incandescent lighting plant.

MONMOUTH, OR.—An effort is being made to improve the water works and put in an elecric light plant.

DUNSMUIR, CAL.—E. M. Cutting is installing an electric lighting plant at the Tie Works at Chestnut.

ROSSLAND, B. C.—The Rossland Light and Water Company has about completed its electric installation.

DALLAS, OR.—An effort is being made to improve the water works and place an electric plant therein.

SAN FRANCISCO, CAL.—H. L. Middleton has purchased a 200-light Westinghouse incandescent dynamo.

COLTON, CAL.—The Trustees have adopted an ordinance of intention to erect a municipal lighting plant.

EUGENE, OR.—An incandescent lighting plant has been placed in the gymnasium of the State University.

GREAT FALLS, MONT.—The Castner Coal & Coke Co. will put in a $22,000 electric plant for lighting purposes.

VANCOUVER, B. C.—The Western Electric Lighting, Heat and Power Company is to light the city by electricity.

EUREKA, CAL.—The Pacific Lumber Company is installing a 34-kilowatt incandescent Westinghouse lighting plant.

GRASS VALLEY, CAL.—The W.Y.O.D. Mine is installing a 33-kilowatt Westinghouse incandescent lighting plant.

FOREST GROVE, OR.—W. S. Ingles, Wm. Kane and J. C. Woods have been appointed water and light commissioners.

MILES CITY, MONT.—This city has voted to isssue bonds for the purchase of the water works and electric light plant.

MURRAY, IDAHO.—An incandescent lighting plant has been installed in the mine and mill of the Daddy Company.

FORTUNA, CAL.—Swartzel & Williams are installing an incandescent lighting plant, using Westinghouse apparatus.

SANTA CLARA, CAL.—The Index favors the erection of a municipal plant of 50 arc lights and about 500 incandescents.

JACKSON, CAL.—B. E. Letang, of the Gas Company, has ordered a 30-kilowatt Westinghouse alternator for his new plant.

LOS ANGELES, CAL.—A 12½ kilowatt slow speed multipolar incandescent dynamo has been installed in the Baker Block.

MILES CITY, MONT.—The Council has authorized the issuance of $17,000 in bonds for an electric light and water works plant.

HONOLULU, H. I.—Mr. W. I. Warriner has been appointed electrical inspector of the Honolulu Board of Fire Underwriters.

REDWOOD CITY, CAL.—The Westinghouse Company has sold a 45-kilowatt alternator to J. George Gardner for use in this place.

FORT JONES, CAL.—Emanuel Perrira has purchased a 45-kilowatt two-phase lighting plant from the Westinghouse Company.

GRANTS PASS, OR.—The Maybelle Mining Company has installed an incandescent lighting dynamo at the Gold Basin mines.

TRAIL, WASH.—An electric lighting plant will be put in to light trails near smelter, and the smelter plant will also light the town of Trail next year.

ROSSLAND, B. C.—The War Eagle Mine is installing compressors, machine drills and hoists, and will put in an incandescent plant to light the mine and town.

WINNEMUCCA, NEV.—The installation of a gasoline engine and incandescent dynamo in the State Capitol Building is being considered.

ROSLYN, WASH.—Mr. Sprandel has been given sixty days to start up his electric light plant or remove his poles and wires from the street.

NELSON, B. C.—The Nelson Electric Light Company expects to have its new plant in operation by December 20th. John B. Bliss is electrician.

PORTERVILLE, CAL.—The Pioneer Land Company has agreed to put in an incandescent lighting system, provided sufficient patronage is assured.

EUREKA, CAL.—The Eureka Lighting Company has entered into a contract to furnish the city with 63 arc lights for one year at $500 per month.

SAN JOSE, CAL.—The San Jose Light and Power Company has installed an additional Brush No. 7 arc-lighting dynamo complete, with all accessories.

JUNEAU, ALASKA.—The Electric Light Co. has installed a Pelton water-wheel to run under a seventy-foot head, displacing the turbine heretofore used.

GLEN ELLEN, CAL.—Governor Budd advocates the installation of a plant to furnish electric lights, heat and water in the Home for the Feeble Minded.

JACKSON, CAL.—B. E. Letang, of the gas works, has completed the pole line for his new electric plant, and expects to furnish current for lighting shortly.

WATSONVILLE, CAL.—Francis Smith has purchased two 35-kilowatt two-phase Westinghouse dynamos, to displace the single phase apparatus now in use.

HONOLULU, H. I.—Welch & Co. have purchased a 12-kilowatt general incandescent lighting plant from the Westinghouse Co. for use on the Ewa plantation.

WILLOWS, CAL.—The Board of Supervisors has advertised for bids to be in on January 8th, for a 250-light gas plant for the Court House and County Jail.

BERKELEY, CAL.—The University grounds are to be lighted by electricity from the electric plant in the department of electrical engineering of the University.

LAKEVIEW, OR.—Hon. H. V. Gates, who put in the electric light works at Klamath Falls, is expected here to figure on a roller mill and an electric light plant.

WOODLAND, CAL.—The arc lighting plant of the Woodland Electric Light Company is fully loaded, and an increase may be necessary. Homer Dunton is electrician.

PORTLAND, OR.—J. F. Steffan has secured the contract for the construction of the Government light ship No. 67, which will contain an elaborate electric light plant.

SUTTER CREEK, CAL.—The station of the local electric lighting company is to be enlarged by the addition of a 120-kilowatt alternator, which has been ordered from the General Electric Company.

SPOKANE, WASH.—The Oppenheimer Rolling Mills are to be lighted by electricity.—The Consumers' Liight and Power Company is erecting 75-foot poles throughout the city for its new plant.

SANTA CLARA, CAL.—It is proposed to install a municipal lighting plant in the city water works, with the surplus of $7000 that remains from the $60,000 bonds voted last year for the water plant.

SAN JOSE, CAL.—The Board of Trade has adopted a resolution favoring the municipal ownership of an electric light plant, and has asked the Council to submit the proposition to a vote of the people.

GRASS VALLEY, CAL.—The contract for street lighting for 1896 has been awarded to the Grass Valley Gas and Electric Light Company, John Glassen, Manager, for $125 per month, all night lighting.

FOREST GROVE, OR.—The city has purchased the Canning Electric light plant for $10,500, and will enlarge same and operate it in conjunction with the new water works.

SANTA ROSA, CAL.—The Merchants' Lighting Company has added a 250-horse-power Buckeye engine to its lighting plant. Herman Webber is manager of the Company.

OROVILLE, CAL.—The Oroville Gas, Electric Light and Power Company has enlarged its plant by the addition of a new Westinghouse alternator, and is now rewiring the town.

NELSON, B. C.—The Nelson Electric Light Company has received its electrical apparatus from Petersborough, and the new plant will soon be in operation. John B. Bliss is electrician.

PETALUMA, CAL.—The Petaluma Electric Light and Power Company, largely owned by the estate of the late W. S. Pierce, has been sold to J. B. Burdell, the price paid being understood to be about $20,000.

ASTORIA, OR.—There is talk of an electric light plant being installed at some convenient point on Yaquima bay, so as to reach all the towns willing to patronize such an enterprise, provided 400 lights are guaranteed.

SAN LEANDRO, CAL.—The people have voted to issue bonds for $10,000 for the erection of an electric light plant, the vote being 274 for and 25 against the proposition. The use of a gas or vapor engine is probable.

COLTON, CAL.—Specifications have been issued by E. C. Sharpe, electrical engineer, for the installation of a 50-kilowatt municipal lighting plant to be operated by a 3-phase motor, run by power to be taken from the Redlands plant.

HAYWARDS, CAL.—The Council has awarded the contract for the city lighting for the ensuing year to the Haywards Electric Light Company for $9 per 2000 candle-power arc lamp per month until midnight on moonlight schedule.

SANTA MONICA, CAL.—A 55-kilowatt incandescent lighting dynamo, direct connected to a 9½x15-8ths Union Iron Works vertical engine, running at 380 r. p. m., is being installed in the Soldiers' Home. The distinctive feature of the plant is that it is to burn 220-volt lamps.

BURKE, IDAHO.—H. Jackman and Norman Ebley will build an electric light plant in Canyon Creek, for the purpose of supplying lights at Burke and Gem and all intermediate points. The plant will be located at the head of the Frisco flume, the water being brought from a point on Canyon Creek.

SALT LAKE, UTAH.—The Salt Lake and Ogden Gas and Electric Light Company proposes to meet the heavy cut made in incandescent electric rates by the Citizens' Electric Light Company by putting in Wellsback burners burning natural gas, at the rate of ten cents per lamp per month, if necessary.

CASCADE LOCKS, OR.—A Pelton water wheel will probably be installed for driving a dynamo to furnish incandescent lights to this place, the wheel being operated by water taken from a 10-inch wrought iron pipe that has been laid for operating the hydraulic headgates of the canal, the fall being 600 feet.

MONTESANO, WASH.—Albert Daub declined to accept the term for the electric light franchise offered him, and the proposition is again open. Water power was to have been used, and it is stated that, outside of the lights to be taken by the city, the monthly income of the plant would probably be in excess of $150.

SPOKANE, WASH.—The Board of Public Works has asked the City Council for permission to place a 60-light incandescent plant in the water works, but the opinion is held by some that the city ought to put in two dynamos sufficient to furnish 200 arc lights for lighting the city instead of putting in this proposed small plant to furnish lights for the water works alone.

VANCOUVER, B. C.—An agreement with the Western Electric Co. had been practically accepted by the Common Council, when G. De Wolf appeared and offered to light the city for 26 cents per lamp per night for the present number of lamps, which is 1½ cents cheaper than the figure of the Western Electric Company. Mr. De Wolf presented a certified check for $1000 as a token of good faith, and his proposition will receive consideration.

SEATTLE, WASH.—Among recent installations by the Seattle Gas Fixture Company was a 50-volt 150 ampere hour storage battery plant, using chloride cells.——Samuel Hill and some of his Eastern associates have purchased the Seattle Gas and Electric Light Company, the reputed purchase price being $750,000. The Company was organized in 1873, with John Leary as the principal owner. Some years afterward A. A. Denny and Dexter Horton became associated with the enterprise, and shortly after the great fire of 1889 they sold their interest to H. G. Struve, Maurice McMicken and Lester Turner, who were in control when the transfer was made to Mr. Hill.

SAN FRANCISCO, CAL.—A 4-kilowatt incandescent dynamo direct coupled to a high speed engine has been placed on the Steamer Everett.——The Golden Gate Dredging Company has installed an incandescent plant on its new dredger.——Forty constant potential arc lamps of the General Incandescent Arc Lamp Company have been sold by the Abner Doble Company for use in the Sutro Baths. Inverted arcs, with reflectors, will be used over the tanks.——The Christmas tree at the Denman Grammar School was lighted by over 100 miniature incandescent lamps, manufactured by G. E. Lamont.——Messrs. J. W. Brooks & Co. sold over 25,000 "Universal" incandescent lamps in Oregon and Washington between Nov. 15th and Dec. 10th.

RIVERSIDE, CAL.—E. C. Sharpe, electrical engineer for the city of Riverside, has issued specifications for the installation of the municipal lighting plant for which bonds have been issued. Power will be purchased from the Redlands Electric Power and Light Company, and will be conveyed to the city over a special circuit. The plan necessitates the installation of a 300-kilowatt three-phase generator at the Redlands power house, seven miles from Redlands, and the construction of an independent circuit thence to Riverside, line loss being 5 per cent. and the distance approximately fifteen miles. Fifty kilowatts of energy is to be taken from the Riverside circuit for delivery at Colton, and in Riverside is to be erected a complete sub-station for municipal lighting purposes. Bids must be in by December 30th.

ALAMEDA, CAL.—City Electrician G. A. Wiese's report for November shows the cost of operating the municipal lighting plant during that month to be $1,308.77, from which is to be subtracted $194.71 for new construction, making the actual running expenses to be $1,114.07, the service consisting of 100 city lights on moonlight schedule and 1,375 commercial incandescents. The income from private consumers was $323.15. The income from the city at the same rate as charged for gas previously, but with twice the service in some cases, $71.17; total income, $394.32. Cost of electric street lighting to the city, $719.74. Cost per month per lamp for November, $7.20; for October, $6.16; September, $5.94; August, $7.03; average cost per lamp per month to the taxpayer, $6.58. ——A proposition emanating from the Oakland Gas, Light and Heat Company, that bids be asked (1) for furnishing electric power for operating the arc and incandescent generators in the municipal plant, and (2) for furnishing current for the maintenance of the municipal arc-lighting plant for street purposes only, has been rejected by the City Trustees.— Trustee Clark, of the Electric Light Committee, states that work will be commenced soon on the improvement to the city's electric light plant. A lot has been bought at the foot of Park street, and new buildings will be erected to accommodate new machinery. It is intended to put in a 350-horse-power engine, three new boilers, and dynamos sufficient to run 3500 incandescent lights. The improvement will cost $15,000, which has been provided for in the tax levy.

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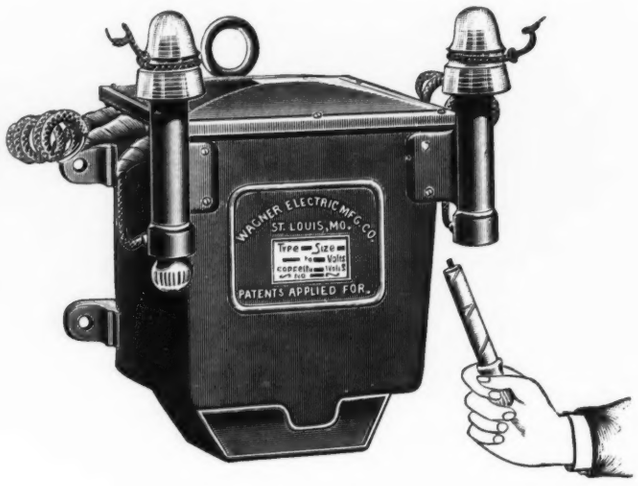

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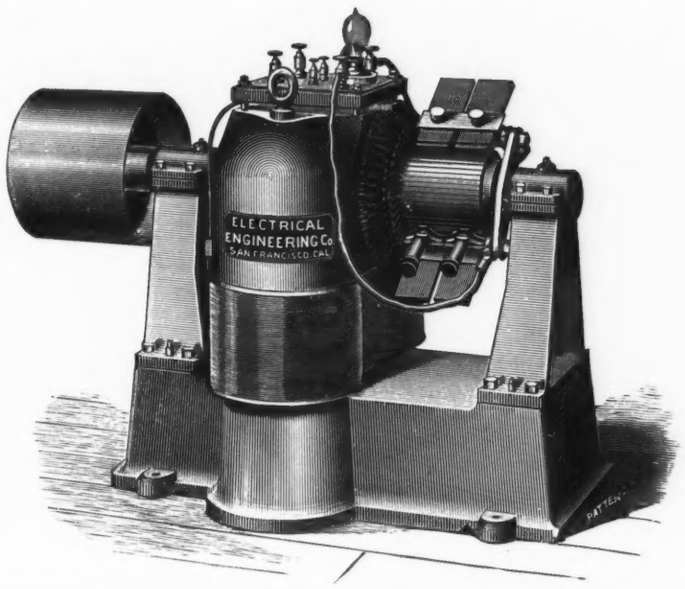

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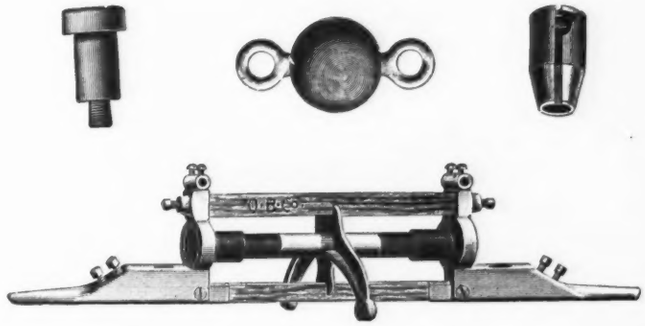

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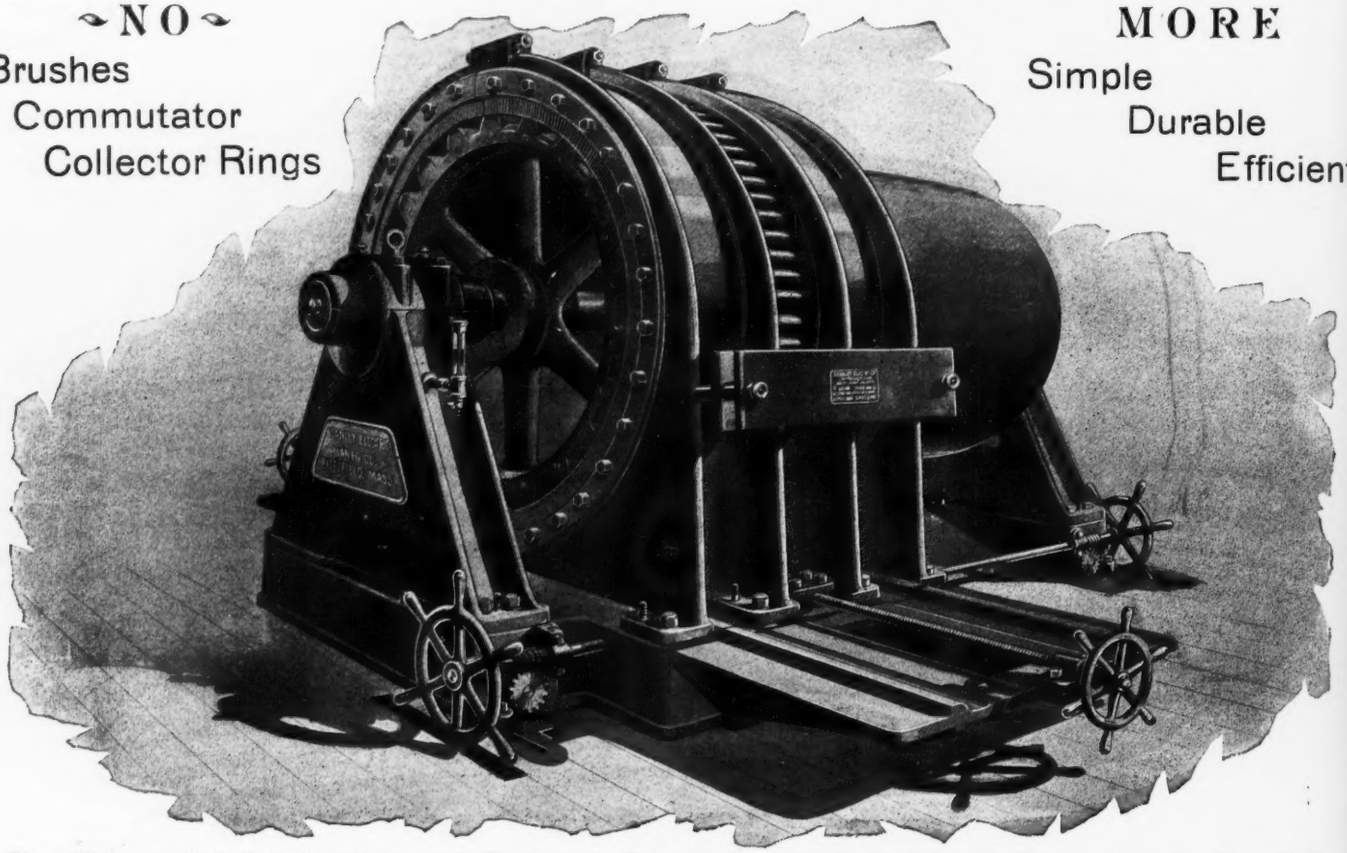

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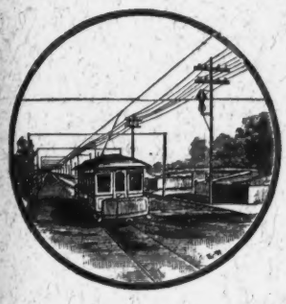

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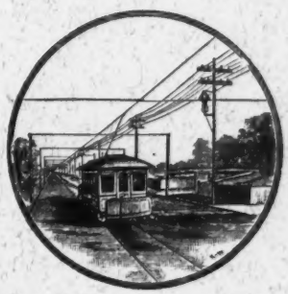

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